Environmental Impact Assessment

For
Spanish Lookout Community Corporation Ltd.
Proposed Farming Development Located Near

Runaway Creek and Sibun River Along The Coastal Highway, Belize District

Final Report
May 2025

Belize Environmental Technologies

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ABSTRACT

The Spanish Lookout Mennonite Community has significantly expanded their agricultural activities in new areas and are currently undertaking an additional venture to expand their agricultural efforts primarily in grain production in land once belonging to Tiger Sandy Bay Farms Limited located near mile 31 on the George Price Highway and extending near Runaway Creek and Sibun River along the Coastal Road. In January of 2022, the Spanish Lookout Community Corporation Ltd. (SLCCL) and Tiger Sandy Bay Farms Limited signed an agreement for the purchase of this land which covers an area of 6719 acres.

Of the 4052 acres of land slated for agricultural use, more specifically the growing of grain crops, 2,751 acres had already been cleared and is already under production. Only 1,301 additional acres are proposed to be cleared. The areas proposed for agricultural use are located in land systems that have been classified for agriculture production. This project is supportive of GOB's effort in ensuring Belize's food security.

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ABBREVIATIONS

°C	degree centigrade
AWS	Automatic Weather Station
BAHA	Belize Agriculture Health Authority
BAS	Belize Archaeological Services
BET	Belize Environmental Technologies
BMDC	Belize Marketing and Development Corporation
BMP	Best Management Practices
BRCP	Belize Research Cave Project
BTB	Belize Tourism Board
CARDI	Caribbean Agricultural Development Institute
CAT	Category
CBOs	Community-Based Organizations
CPA	Certified Pesticide Applicator
dbh	diameter at breast height
DEM	Lidar Digital Elevation map
DEMO	District Emergency Management Organization
DOE	Department of the Environment
ESMP	Environmental and Social Management Pan
GCMs	global climate models
GOB	Government of Belize
GPD	Gross Domestic Product
GPH	George Price Highway
gpm	gallons per minute
GPS	Global Positioning System
GUP	General Use Pesticide
HCL 2	Hummingbird Citrus Limited 2
IICA	Inter-American Institute for Cooperation on Agriculture
km	kilometres
L/min	Litres per minute
m	meter
mg/L	mg per litre
mi	miles
mm	millimetre
NEMO	National Emergency Management Organization
NEPPOS	National Emergency Preparedness Plan for Oil Spills
NGOs	Non-governmental Organizations
NMS	Belize National Meteorological Service
PCB	Pesticides Control Board

PGIA	Philip Goldson International Airport
ROC	Republic of China (Taiwan)
RUP	Restricted Use Pesticide
RWS	Rudimentary Water Systems
S.I.	Statutory Instrument
SLCCL	Spanish Lookout Community Corporation Ltd.
SWaMA	Solid Waste Management Authority
TBS	Tiger Sandy Bay
TPI	Topographic Position Index

EXECUTIVE SUMMARY

Introduction

The Spanish Lookout Mennonite Community has significantly expanded their agricultural activities in new areas and are currently undertaking an additional venture to expand their agricultural efforts primarily in grain production. In January of 2022, the Spanish Lookout Community Corporation Ltd. (SLCCL) signed an agreement with Tiger Sandy Bay Farms Limited to purchase their property covering an area of 6719 acres, comprising of several parcels, located near Mile 31 on the George Price Highway and extending near Runaway Creek and Sibun River along the Coastal Highway.

Chapter 1 provides information on the proposed project and its general location so that the scope of the project and its related activities can be best placed into context.

The Property

The Tiger Sandy Bay Farms Limited land was acquired from James and Steven Downard. The land includes three different parcels adjacent to each other. The property is currently being resurveyed for accuracy.

1. PSN-53531 being 5301.45 acres of land situate on the east bank of the Sibun River and known as Tiger Sandy Bay held via a Transfer Certificate of Title dated May 7,1999 Recorded as Volume 34 Folio No.1

2. PSN-53532 being 30.00 acres of land situate at Tiger Sandy Bay at Mile 33 on the Western Road, Belize District held via Deed of Conveyance dated and recorded in Deeds Book Volume 3 of 1983 at Folios 493-498

3. PSN-67382 being 1387.62 acres of land being a portion of Orange Walk and Monkey Bay Works situate on the east side of the Western Highway (now the George Price Highway (GPH) in the vicinity of Mile 32 as shown on Survey Plan by A.R. Marin and recorded at the General Registry in Belize City in Surveyor's Plan Book No.7 at Folio 83B held via an Indenture dated the April 15, 1999, and recorded in Deeds Book Volume 12 of 1999 at Folios 507-512.

Tiger Sandy Bay Farms had previously cleared much of the land which is currently in grain production by the new owners. Most of the previously cleared area was once under citrus production with many of the trees affected by citrus greening with the orchard appearing abandoned in some areas. The previous owners had placed the land on the real estate market as they felt they could no longer keep up the operations.

Project Activities

The project involves the use of some 6,719 acres of land for planting crops, conservation and mining. The present land use indicates that 2,751 acres (41%) of the property is cleared and being used for agriculture, mainly grains (corn, bean sorghum) with just a few citrus trees still left standing. There is 1301 acres (19%) of disturbed land with secondary growth to be further used for agriculture production, primarily grain crops. An additional 550 acres (8%) of elevated area (hilly) is being zoned and left for future quarrying activities. This area has an active Excel Quarry with non-operational Tiger Aggregates Quarry adjacent to it.

The present plan will set aside 1,649 acres, which is 25% of the land for conservation purposes or for future ecotourism development. The section of this property is also hilly and contains numerous caves with several of them containing Mayan pottery. It borders Monkey Bay Wildlife Sanctuary and is used by them for tour guiding activities in the area. In addition, there exist 468 acres (7%) of river and water ways reserve area, inclusive of a 150 feet wide riparian reserve along the Sibun River, for a total of 32% of land to be left in reserve or for sustainable use.

As a socially oriented community, the development strategy for the Spanish Lookout Community Corporation Ltd. was to functionally subdivide the 4,052 acres among investors (producers) in the community for development and the planting of the crops of mutual interest. The present group of producers have chosen to plant grain crops (soybeans, sorghum, corn and highland rice) with some of these crops rotated.

The present 2,751 acres of land is under mechanized grain cultivation using modern agricultural equipment for all phases of cultivation, from soil preparation to harvesting. A 150 feet wide riparian reserve has been set aside for those agricultural plots bordering the Sibun River.

To achieve optimal growth and maximum yield, the farmers intend to implement Best Management Practices (BMP). These practices have been successfully developed and implemented on other existing agricultural lands owned by the Spanish Lookout Community. By incorporating these BMPs into the project, their aim is to enhance efficiency, improve their agricultural related practices while ensuring environmental sustainability. Their aim and approach are that these Best Management Practices will lead to higher yields and greater financial success.

Land Clearance

The land clearance of the 1,301 acres recommended for agriculture production is based on the rapid survey of the flora and fauna of the project area. The survey indicated that the commercial tree species in the present stands were small and had no timber value with hardly any salvaging value. All trees were mainly of small girth and could easily be cleared by the land clearance machinery such as bulldozers.

Most of the vegetation will be cleared using two bulldozers that are joined together with a large link metal chain between them and spaced about 50 yards apart and facing the same direction. The process is called “chaining”. The two bulldozers will synchronize their speed and proceed travelling together in parallel in the same direction. Within minutes, the chain will cover a wide swath of land and at a point, the bulldozers will turn around and begin heading back in the other direction, like a giant lawn mower with the chain as the blade. The chain has the effect of uprooting all trees and brush in its path. This method is more effective, efficient and less impacting to the soils as the bulldozer travel paths are reduced, therefore less soil compaction. Any salvageable material is then selectively pulled aside by mechanical means using a tractor and a gang of workers. Some trees will be salvaged for bush-sticks, fence posts and timber.

The clearance and salvage of the vegetation would be done under a salvage license. Once this process has been completed, the remaining bush is left to dry, then burnt. The bulldozers, using a root rake, then pile the remaining burnt debris into mounds where it is re-burnt. The root rake is utilized so as to preserve the integrity of the top-soil as much as possible.

Crop Production and Harvesting

Once the area has been cleared, the soil is tilled and prepared for the mechanical sowing of the grain seeds. Any remaining vegetation that was not burnt is pushed in heaps and eventually mulched and left to rot after which it is reintegrated into the soil to improve its humic content.

There are a number of crops that the SLCCL has successfully produced on a consistent basis – these include beans, corn, rice and soybeans. Crops grown are often rotated from one crop to another. The farmers practice this rotation of crops in the same area across a sequence of growing seasons oftentimes times obtaining more than one crop per year increasing productivity. This practice also reduces the reliance of crops on one set of nutrients. It also reduces pest and weed pressure and the probability of developing resistant pests and weeds. This crop rotation strategy is conducted without the intervention of any inputs from irrigation. A few farmers voiced their intention to grow high-land rice that does not require any irrigation and where the planted variety is indistinguishable from low-land rice.

The land clearing equipment and those used for tilling, sowing and harvesting are brought from Spanish Lookout and other nearby areas owned by the SLCCL significantly reducing their cost of production as the rotational use of these equipment allow for their optimum utilization. Although production will rely solely on rain fed farming, for planning purposes it is recommended that the demand for water be estimated.

This method is commonly used in many countries, especially in regions and areas where water is scarce. From an environmental viewpoint it reduces the effluent stream, thus reducing the impacts of pesticides and fertilizers use on the adjacent Sibun River and from an economic viewpoint, it reduces the cost associated with pumping and water abstraction.

Crop Processing

There will be no processing of any crops in the proposed area. Facilities that already exist in Spanish Lookout and other areas will be utilized for the processing, packaging and storage of products from the new land under production and those remaining to go into production. The activities proposed are those related to the clearing of the additional lands, its tilling, sowing and farming of grain crops.

Storage Facilities

There are no plans for the construction of storage facilities to store the beans and grains being farmed. All the produce will be harvested and transported to storage facilities in Spanish Lookout.

Homesteads

No homesteads are being considered for construction in the near future. However, there are two buildings at the present entrance of the northern section of the development that are used for the housing of workers and the other for the equipment operators. These buildings are provided with potable water and appropriate liquid and solid waste disposal system. All future buildings to be constructed within the development are to have the approval from the Central Building Authority and also approval for all electrical installations by the Public Utilities Commission.

Chapter 2 provides background information on the physical and biological environment of the area. This chapter provides the baseline information of the Study Area and includes additional background environmental information collected by the EIA team of the project area and its immediate surroundings. It also included the gathering of relevant baseline data on the ecology, climate, geology, hydrology, stream flow and water quality of the project area. The information is presented by providing a general background of the Study Area and then narrowing the information to the project site.

Topics covered are climate, climate change issues, hydrology and description of the Sibun River Watershed and its sub basins, flow discharge in the Sibun River and tributaries, Groundwater, regional geology and geology of the area, land system and drainage density, topography, forest cover, and water quality baseline data of the project area.

Chapter 3 outlines the current legislation and regulations that pertain either directly or indirectly to the regulation of the proposed project and its related activities and also other legislation and policy related to the use and management of Belize's natural resources and serves to guide environmental planning and development before and during project implementation.

It is important to identify those legislations which will need compliance by the proposed project with respect to its planning and implementation. The Department of Environment, the Department of Forest Department, Agriculture Department, Lands and Survey Department, and the Geology Department are the main regulatory bodies of the various instruments affecting the proposed project.

Chapter 4 addresses the Impacts To Flora And Fauna.

Vegetation And Ecosystems

The natural vegetation in SLCCL (previously known as Tiger Sandy Bay) property reflects the geology and hydrology of the terrain. The vegetation can also be grouped into distinct ecosystems. Vegetation types/ecosystems are typically found to be arranged around distinct geological and hydrological features. The more relevant of these have been presented elsewhere in this report. Repeated naturogenic disturbances such as hurricanes, and anthropogenic events such as wildfires, and logging, have also influenced the development of these ecosystems. Within the SLCCL property, land use change (and to a certain extent land use planning), has been guided for the most part by the potential of geology and soils, where natural ecosystems have been replaced with cultivated crop systems and quarrying. Consequently, most of the natural ecosystems on the SLCCL property have been reduced in area by land use changes.

Methodology

The methodology employed in conducting the terms and objectives of this study relied on the relevant proven and much used protocols that have been used to conduct floral and faunal surveys at the required intensity. Planning for information gathering in the field was informed by bibliographical research, remote sensing imagery, and personal communications.

The availability of good resolution satellite imagery has greatly enhanced our capacity to assess vegetation cover. Although different satellite imageries were used in this assessment, the scenes from Landsat 9 at a moderate resolution of 15 meters provided a clear image of the study area for the purpose of determining natural vegetation cover and changes in land use over time.

Natural vegetation ecosystem for Belize were mapped in 2001 and periodically updated since (Meerman and Sabido, 2001, Meerman and Sabido 2017). This ecosystem map therefore forms the basis for vegetation type mapping in the SLCCL property.

Changes in the composition of vegetation populations that have occurred over time can only be verified by on the ground field visits and assessments. For example, the area of SLCCL has been subject to at least three hurricanes in the last two decades or so (Richards-2010, Earl-2016, Lisa-2022) and the wildfires that normally occur in these hurricane-impacted areas during the subsequent dry season has also had an impact on the ecosystems in SLCCL. Extreme climate change related fire weather has also contributed to the occurrence and intensity of wildfires in the area. In April 2024, the pine savannas in the area of SLCCL experienced annual wildfires (most if not all of anthropogenic origin) but in May wildfires had spread to the adjoining broadleaf vegetation where wildfire is not a frequent occurrence. It should also be noted that the flora and fauna in representative ecosystems found in adjoining properties particularly those forming part of the Central Biological Corridor have been the subject of continuous study and monitoring.

This data has greatly informed the current assessment of the ecosystems represented in the SLCCL property. The main ecosystems identified were visited and where relevant an assessment of the species present was made by establishing on the ground standardized transects in order to assess current species composition, diversity and vegetation structure, although it was not considered necessary to assess all ecosystems.

The methodology used for the vegetation transects has been adapted from the methodology used by the Forest Planning and Management Project in Belize (Shawe, 1997) and subsequently adapted by Meerman (Meerman, 2003). This methodology involved opening of a 200-meter-long line just wide enough to provide access through the vegetation and minimizing the unnecessary removal of any vegetation. A 2-meter band on each side of the cutline was continuously surveyed thus effectively covering a transect survey area of 200 meters by 4 meters. In this transect, all trees with a diameter at breast height (dbh) or 1.3 meters vertically from the ground of 10 centimetres or more are counted, measured and where possible identified. Only those stems that had their base within the transect (important in the case of leaning trees) were counted.

All other herbs, vines, saplings, shrubs etc. were identified to the closest level possible. It should be noted that many plants cannot be identified to species when not in flower and/or fruit. Data gathered from each tree measured included the following: a)Common name, b)Scientific name, c) Stem height, d)Crown form, e)Canopy closure, f) Dead trees and g) Description of understory and identification of understory species at the start and end of every 100-meter point.

A total of nine (9) transects were surveyed. The data obtained allows the assessment and calculation of biodiversity in the property. It is universally accepted that vegetation is the basis for terrestrial ecosystems and biodiversity. Therefore, by extension floristic biodiversity is a good proxy for overall ecosystem biodiversity.

Results

Three (3) natural vegetation ecosystem classes were identified within the SLCCL property. These are:

a) Lowland broad-leaved moist forest; b) Lowland broad-leaved moist scrub forest and c) Lowland savanna.

The lowland broad-leaved moist forest accounts for 57% of the remaining natural vegetation cover on the SLCCL property and once covered a large portion of the area presently converted to agricultural use. The vegetation surveys conducted within SLCCL confirmed a complex matrix of ecosystems each with their typical array of associated species. These ecosystems tend to transition into one another, making it impossible to accurately draw distinct boundaries between them.

Summary of Flora Surveys

It should be noted that no rare and endangered species were found in the SLCCL property. The ecosystems identified in the property are found adequately represented several times in the adjoining land areas including protected areas such as Monkey Bay Wildlife Sanctuary, Monkey Bay National Park, and Runaway Creek Preserve. While these ecosystems outside the property are also subject to frequent wildfires and extreme climate change driven weather conditions, they may be better protected from anthropogenic impacts such as illegal logging, and hunting. There was a marked absence of timber trees of commercial size observed in the property or recorded in the transects. Salvage logging in the areas yet

Fauna/Wildlife Methodology

Floristic biodiversity is a good proxy for overall ecosystem biodiversity. Therefore, most wildlife surveys were opportunistic within the vegetation type transects used in the field vegetation surveys, although opportunistic recordings were also utilized throughout the SLCCL property whenever possible. Direct field observations are complemented with data from previous studies either within the SLCCL property or in similar ecosystems particularly in the protected areas adjoining the property. The increasing popularity of citizen science platforms such as iNaturalist and eBird have also contributed to the faunal database.

Birds

Birds were assessed using spot counts and opportunistic recording while conducting the floral survey on the transects as well as any other walks through the study area. Both visual and vocal characteristics were used for identification. The bird survey was linked to the ecosystem types. This method of inventory gives a good indication of the biodiversity in the transects.

Mammals

Different methodologies are required for a thorough mammal survey. Camera “traps” or trail cameras are increasingly used for larger mammals and live traps can be set for smaller mammals. Nearly every species requires a separate approach. It often takes years to obtain meaningful data as the overall success rate of these methodologies can be very low. Consequently, for the purposes of this study, mammals were assessed

by direct opportunistic observation along the study transects, interviews with persons known to frequent or work in the area and complemented by data gathered either from previous studies or by citizen science platforms such as iNaturalist.

Birds Recorded

A total of 53 bird species were recorded. For comparison the adjacent Monkey Bay Wildlife Sanctuary has recorded 333 species, but it should be pointed out that these records span several years throughout the 12 months of the year whilst recordings in SLCCL occurred over a few days during the dry season months. The four most recorded species in the SLCCL survey were Brown Jay (*Psilorhinus morio*), Smokey-brown Woodpecker (*Dryobates fumigatus*), Spot-breasted Wren (*Pheugopedius maculipectus*), and Yellow-green Vireo (*Vireo flavoviridis*). No bird recorded is listed as rare or endangered.

Conclusion

Even though historic and current agricultural development within SLCCL will have removed natural vegetation cover on about 75% of the land, the retention of 25% as conservation land plus the riparian buffers will continue to provide an important habitat for most of the species of wildlife that are found within the SLCCL property. However, perhaps even more importantly, is the connectivity function provided between Runaway Creek Nature Reserve and Monkey Bay Wildlife Sanctuary. Both properties are part of the Maya Forest Corridor. The protection of this conservation area within the property from fire, illegal hunting, and illegal logging would greatly assist to improve habitat function.

Chapter 5 addresses **Water Resources Management** issues. The assessment indicated that the available freshwater sources for drinking, domestic needs and watering of plant and crops are the following: bottled water, groundwater, rainfall water harvesting, pond water and river water from the Sibun River.

At present, the Belize Water Services Limited (BWSL) water distribution network does not extend to the project site. Nearby La Democracia Village and Mahogany Heights obtain their water through Rudimentary Water Systems (RWS), while commercial businesses in the area utilize bottled water for drinking, and rainwater and treated pond water for domestic purposes. The project is an agriculturally based development which does not entail any homesteads and the limited domestic water use is limited to drinking water and water for sanitary uses by farm workers.

The impacts on water resources have been evaluated in connection with the main activities that will be conducted in the Spanish Lookout Community Corporation farming development. Some of these activities are avoidable and reversible. The majority of the land has already been converted to crop land, and clearing of the remaining broadleaf forested area or wahmil will be minimal. Impacts of farming operations on the environment will be the introduction of chemical fertilizers, agrochemicals and sedimentation of ploughland in the floodplain. Mitigation measures to reduce the impacts of these activities are proposed for consideration and implementation by the proprietors.

Chapter 6 focuses on **GEOLOGY AND SOILS** and addresses issues related to its proposed agricultural uses.

Based on the British Honduras Provisional Soil Map of Belize developed by the Directorate of Overseas Surveys, 1958, and on the revised classification of soils by Baille et al, 1993, a regional appreciation for the soil types throughout the development can be had. Detailed onsite inspections and test pits were used to provide site specific soil profiles and characteristics.

Regionally the development lies in an area that exhibits two main soil suites, mainly the Puletan and Tintal Suites, which consists of primarily coastal deposits, alluvium and colluvium.

Soils Investigation

The objectives of the soil testing are to determine: 1. Soil permeability, 2. Soil Profile and 3. Potential risks and associated impacts' activities such as agriculture, and associated activities: 1. Soil permeability: The moisture in the soil is a basic input to crop production, hence the need for the determination of the permeability in the development site. Permeability is an indication of the ability of the soil to store water. The more permeable the soil is, the greater the seepage; 2. Soil profile: The soil profile will assist in determining the of type soil that is found in the development and by extension its potential fertility Note: Determining soil fertility is best derived from random soil analysis; and 3.Potential Risks and Associated Impacts: These are the potential risks and associated impacts which may result on the soils of the project arising from activities such agriculture, and associated activities such as ploughing, etc.

Soil Fertility

Based on the soil classification above, the land can be generally considered as a Silty soil which is usually more fertile than other types of soil, meaning it is good for growing crops. Silt promotes water retention and air circulation. Too much clay can make soil too stiff for plants to thrive. In many parts of the world, agriculture has thrived in river deltas, where silt deposits are rich, and along the sides of rivers where annual floods replenish silt.

Throughout the development there is a variation of soil fertility potential. According to Wright et al, 1959, the northwest and southern portions of the property have low soil potential with a soil fertility value of 4.5, the central portions of the property have a high soil potential with a soil fertility value of 1.2, and some small sections with the southern portions having medium soil potential with a soil fertility value of 3.

Onsite soil analysis of the crop productivity within the development indicates however that approximately 65% the property has very high crop productivity potential, 32% of the property has high crop productivity potential, and <3% of the property has moderate to low productivity potential. This result is in keeping with the onsite analysis of the soil profiles.

Chapter 7 addresses **AGROCHEMICAL USE AND MANAGEMENT** related issues**.**

The prudent use and management of the agrochemical inputs is perhaps the issue with the greatest potential environmental and social concern associated with the operational phase of the project. The use of restricted use pesticides requires that the use of these pesticides be done by certified trained pesticide applicators since these pesticides have the potential to negatively impact human health and the environment. The impacts associated with the use and management of pesticides on human health and the environment have been significantly reduced by initiatives being made in improved regulations and by innovations being made in the manufacturing sector. The production and management of pesticides has seen several notable improvements in recent years such as the following: a) Development of Biopesticides, b) Enhanced Formulations which help in reducing the toxic effects on non-target organisms and the environment; c) Nanotechnology which allows for targeted application, reducing the amount of pesticide needed and minimizing environmental impact; d) Integrated Pest Management (IPM) which combine biological, cultural, physical, and chemical tools to manage pests in an environmentally and economically sustainable way; e) Regulatory Improvements to ensure that pesticides are used safely and effectively, protecting both human health and the environment. These advancements have in turn also assisted farmers and applicators in becoming more aware of the need to ensure the safe handling of these agrochemicals thereby reducing risks to their health and the environment.

Use of Pesticides by SLCCL

The Mennonites of Spanish Lookout in Belize are known for their advanced agricultural practices, which include the use of various pesticides to manage pests in their grain fields. While specific brands and

chemical names may vary over time and among different farmers, common types of registered pesticides (in Belize) used in grain farming typically include the following main pesticides.

The choice of pesticide depends on the specific pests and diseases present, as well as environmental regulations and agricultural best practices. The Mennonites are known for their efficient and responsible farming methods, often following integrated pest management (IPM) practices to minimize the impact of pesticides on the environment. Their IPM program involves the crop rotation method and the rotation of the use of various pesticides so as to avoid pest developing tolerances to any of the pesticide. The crop rotation method utilizing legumes also allows for the cutting down on pest infestations and the use of fertilizers.

Impacts Associated with Agrochemical Use

Given the impacts associated with the use of agro-chemicals, there is the need to ensure its proper use in accordance with the guidelines and instructions for their proper use, use of application methods that reduces risks to the health of applicators and the environment, proper control and monitoring.

The SLCCL utilizes four (4) methods to apply these chemicals, namely: aerial spraying by duster plane, mechanized application, manual spraying and more recently the use of drones. Using pesticides effectively and safely involves following best practices to minimize risks to human health, non-target organisms, and the environment.

Mitigations measures:

1.Read and Follow Label Instructions: Always read the pesticide label for specific instructions on application rates, timing, and safety precautions.

2. Use PPE: Wear appropriate personal protective equipment, such as gloves, masks, and protective clothing.

3. Avoid Drift: Apply pesticides during calm weather to prevent drift to non-target areas.

4. Integrated Pest Management (IPM): Use pesticides as part of an IPM program, which includes crop rotation, biological, and mechanical control methods.

5. Environmental Protection: Avoid application near water bodies and set aside buffer zones to protect aquatic life

6. These pesticides are selected based on their effectiveness against specific pests and diseases and should be used in combination with other pest management practices to optimize crop health and yield.

Chapter 8 addresses **WASTE MANAGEMENT** related issues**.**

Solid Waste Issues

The country of Belize has taken significant steps to improve solid waste management through the implementation of various initiatives led by DOE and the Belize Solid Waste Management Authority (SWaMA). One such initiative was the construction and management of the National Sanitary Landfill located at Mile 34, George Price Highway. As a result of the national solid waste program, a comprehensive solid waste management plan was implemented for the Western Corridor; and in connection with the Waste Management Plan for Emerging Tourism Areas, various reports were prepared including a Waste Characterization study for the Northern and Southern Corridors in 2016. It also included the establishment of several transfer stations where communities can deposit garbage for either recycling or further disposal at the National Sanitary Landfill.

There are no transfer stations near the project area, but the National Landfill is not very far; being approximately sixteen (16) kilometres or less than ten (10) miles from inside the SLCCL farms and to the national landfill. This renders the site fairly accessible for waste disposal services.

Projected Volume of Waste

At the initial phases of the project, it is expected that some domestic waste may be generated, but this is very little. The other major category of waste is the woody and biomass debris from land clearing during the land preparation phase and subsequently the biomass which is left over from the harvesting of products. However, the biomass is processed into the soil for additional fertilizer during land tilling. During the long-term implementation phase, mostly domestic solid waste will be produced by workers on site.

There is only one employee and his wife that resides on site and the rest are day workers that visit the site each day. The total number of workers is ten; but this can increase up to 25 during the harvesting period since more workers are on site at this time. Domestic waste includes waste to be generated by employees during their daily routine. Some waste may be produced but this is primarily from the empty containers after their products have been exhausted. Domestic waste includes waste from scrap food (biodegradable), from discarded food containers, plastics for transportation of food and goods, occasionally from expired plastic water bottles (5-gallon type) and other water bottles, paper and cardboard used for packaging and obtained from grocery store purchase, small pieces of rope for various purposes such tying, discarded toilet waste, plastic film, Styrofoam, rags, clothes, shoes, and small quantities of glass from broken containers etc. It is important to note that most pesticides will be mixed and prepared at the headquarters in Spanish Lookout.

Liquid Waste Management Issues

Liquid waste treatment has as its primary objective the treatment of contaminated wastewater to produce an effluent with levels that can be disposed of without causing harm or with significantly reduced harm to the surrounding environment; therefore, preventing pollution. In this case we are dealing mostly with domestic effluent in the form of wastewater from washing of equipment and structures, and from sewage disposal. The issues associated with liquid waste contamination is assessed as minor as very minor amounts will be generated on site, with the expansive area having the absorptive capacity to adequately deal with the amounts generated which will also receive basic treatment prior to their discharge into the receiving environment composed of expansive farmland.

Chapter 9 focuses on issues related to **ROADS AND DRAINAGE**

Access Roads

The proposed development plan allows for several access points to and from the George Price and Coastal Plain Highways. These access points have not been put in place as per the development plan with the exception of one access point in the southern section of the development. There is an existing established entrance road for the transportation of farm related produce and equipment for the northern and southern section of the development. The northern section has a main access road that is a gate-controlled entrance/exit to the George Price Highway and provides access to the northernmost parcels of the development. The southern section of the development also has an existing established gate-controlled entrance/exit to the Coastal Plain Highway and provides access to the southernmost parcels of the development.

Gravel Road Network and Roadside-Drainage

The existing main gravel access roads within the development are aligned with the roads as shown on the development map. The assigned road reserve widths within the development consists of all reserves being 66 feet wide with 2 exceptions these being 37- and 33-feet wide. The gravel road network consists of access

roads that traverses the entire development starting from the George Price Highway crossing over a timber bridge and from there proceeding onto the Coastal Plain Highway. The access roads are in conformity with the development plan to allow for the movement of the heavy agricultural equipment.

Field Drains

Drainage at the development site and the area designated for agricultural purposes consist of natural drains, field drains and collector/roadside drains. The natural drainage has been interfered minimally.

Field drain's purpose is to allow for the surface water to seep into the ground, the removal of excess surface water to alleviate water logging and to control soil erosion. The existing areas that have been cleared and have been previously used for farming purposes utilize a ridge and furrow or camber-bed cultivation bedding system which is well suited for lands with slopes of 2% - 4%. This system consists of open surface field drains and are connected to collector /roadside drains. The field drains which are wide, shallow and dish shaped are spaced at approximately 120 feet apart. The field drains allow for the easy movement of agricultural equipment from one side to the other.

The outlet/roadside drains are open drains that are trapezoidal in shape, these drains require the installation of culverts to allow the movement of agricultural equipment from one side to the other.

Potential Environmental Impacts of the Drainage System

The impacts associated with the present arrangement for the discharging of excess surface water is the associated suspended solids and agrochemicals that can enter the body of water. It is recommended that sumps or siltation ponds to be installed in catchment areas prior to entering the Highway drainage system. An alternative to this is to place a 1m x 1m x 1m sediment trap at the exit point of any drains that lead into the Coastal Plain Highway drainage network. The maintenance of these is to be conducted on an as need basis or at a minimum of annually prior to the start of the rainy season. The spoils are to be disposed by spreading on the adjacent fields or low areas.

Chapter 10 focusses on the **SOCIAL FACTORS** related to the proposed project and its activities. There are two established village communities in the area of influence, namely, Mahogany Heights and La Democracia Villages. There is also the Maya Forest Corridor Coalition who expressed interest in the development.

Mahogany Heights Village

Mahogany Heights information was gathered primarily via personal communication during a meeting with the village council members and residents living near the community center. The information was corroborated by several other villagers and during the meeting with village council members on June 2, 2024, but credited as personal communication with the first person who shared the respective information. This community profile data collection was a forced imposition, given the absence of an official community profile, and citing the dated 2010 census information would be misleading. The residents engaged were approachable, friendly, and willing to share when asked about the village.

La Democracia Village's information was gathered primarily via personal communication during a public community consultation meeting held on June 2, 2024. In attendance were the village chairman and a councillor. This community is closest to the zone of influence. The public consultation had the full endorsement of the chairman, who suggested the venue, date, and time for the meeting. He assumed responsibility for notifying the community members. The target number of participants expected to attend was 20. Attendees totalled 5 community members. While there is no justification for the poor turnout, the village chairman attested to inviting numerous residents who allegedly said they would attend. The

apparent phenomenon of low turnout for such consultations may be a social issue worth researching, given the importance of such consultation activities.

Survey Instruments

Two survey instruments were used to collect data. A survey/questionnaire instrument to collect micro-level information and a semi-structured questionnaire for use with small groups in meetings or public consultations.

The other data collection instrument used was a semi-structured questionnaire guide to be used in small groups and during public consultations. See Appendix XIII: Semi-Structured Meeting Questionnaire. The meetings were led by a primary facilitator assisted by a note-taker. A field logbook was kept throughout the execution of this work. It was used sparingly to verify nominal level data, record meeting appointments, and initial contact information, to name a few.

General Concerns with the Proposed Development

River pollution, deforestation, and prohibition to access the caves and river are the top reported concerns, followed by river water extraction, smoke pollution due to the burning of fallen forests, destruction of river buffers, and wildfires.

The only benefit stated in a couple of instances was food security. There was a general view that the mechanized farming done by the Mennonite farmers was not labour intensive; consequently, no employment for locals would be available. However, at the public consultation meeting in La Democracia Village, the idea was that perhaps the Spanish Lookout Group could support the school feeding program and help maintain the lawns of some village public spaces in support of the buffer communities. No recommendations to strengthen the benefit were made by those surveyed.

During the data collection period, the village council executives from both Mahogany Heights and La Democracia expressed a desire to meet with members of the development group to hear from them about the project, tour the project zone, and share some of their concerns. On June 22, 2024, the encounter happened, and the ideas exchanged were: 1) The need for the development to be environmentally friendly, 2) Support the surrounding communities directly and indirectly, 3) Breaking down negative stereotypes, and 4) The operational system of the Spanish Lookout Community Corporation Ltd. The encounter between the parties was candid, cordial, and optimistic.

The Maya Forest Corridor

The Maya Forest Corridor is Belize's most important and most threatened wildlife corridor, as it connects the country's two largest forest blocks: the Maya Mountain Massif in southern Belize and the greater Belize Maya Forest that includes Rio Bravo. The corridor provides connectivity for Belize's National Protected Areas System and regional connectivity to the trinational Selva Maya. Measures that allow for safe road crossings are vital to the long-term survival of Belize's wildlife that is a part of cultural heritage, nature-based tourism, sustenance, and livelihoods.

A consultation meeting and site visit was conducted on November 30th, 2024, at the Spanish Lookout Community Corporation Ltd (SLCCL) project site near La Democracia Village, Belize District.

The purpose of the consultation was to meet with the NGO community to familiarize themselves with the proposed project, particularly its components to support corridors through the preservation of buffer zones and riparian forests within the property. It was agreed that a brief report on this consultation will be prepared and circulated, as well as included as part of the EIA consultation process**.**

Chapter 11 provides information on a **RAPID ARCHAEOLOGICAL ASSESSMENT** conducted for the site by the Belize Archaeological Services (BAS).

Research Design

A Rapid Archaeological Assessment (RAA) comprised of a literature review analysis by the Belize Archaeological Services to fulfil requirements related to archaeology in the TOR for an EIA for Tiger Bay Limited was conducted on the property. In addition, field inspection was conducted. Also provided was a Digital Elevation Model of the area, generated from LiDAR data for the area which assisted in the review. The DEM was used to conduct a Topographic Positional Analyses in order to identify anomalies that are often archaeological features on the surface. Since no detailed survey was conducted, the site visits only encompassed visual observation by the author. To complete the literature review, the BAS researched the extant literature available at the Belize Institute of Archaeology and other sources. The results of the survey and assessment are listed below.

Field Observations

On April 25th, 2024, the senior author joined the EIA team of consultants for a site visit at the Tiger Bay property. The visit was to determine the terrain and coverage of the property. During the site visit a drive over of the currently cleared land was conducted and a short visit to the area deemed for conservation. Within the area deemed for conservation several caves were visited, including one cave that was used by the Fosters for filming and Tiger Cave (Peterson 2006). Several other unnamed caves were also visited on this trip.

Conclusion and Recommendations

The purpose of this RAA was to determine whether there are known archaeological sites that would be impacted by planned development in a property that is located to the south of Democracia Village in the Cayo District of Belize. As our review indicates, there has been little archaeological research conducted within the confines of the property under consideration. To the east, few surface sites are presently known, but this area contains numerous caves sites such as those at Tiger Cave, Painted Cave and others in the Runaway Creek Reserve. Given the presence of all these sites in the area encircling the property slated for development, it would not be surprising to find that the latter contains evidence for ancient Maya occupation, possibly in the form of rock shelters or caves that are part of settlements associated with a larger yet to be discovered center most likely in the areas set aside for conservation and mining activities. Although no surface archaeological features were identified on this trip, Petterson (2006) indicates that there was a site nearby that was bulldozed before 1987. A more detailed ground survey of the property could ultimately determine the accuracy of this observation.

It is recommended that at the time of land clearance that if any archaeological artifacts or presence are revealed that the activity be suspended until the Institute of Archaeology are informed and are able to determine what additional steps would need to be followed.

Chapter 12 addresses **CLIMATE CHANGE ADAPTATION & EMERGENCY MANAGEMENT** issues related to the proposed development.

Climate Change Issues

Human-induced climate change is already exacerbating many weather and climate extremes in every region of the world. Evidence of observed changes in extremes such as intense heatwaves, heavy precipitation, droughts, and increased frequency of major hurricane formation in hurricane basins around the world, and particularly their attributions to human influence, has become more evident since the Assessment Report 5 (AR5) of 2013 (IPCC AR6 WGI-SPM, 2021). Heatwaves, floods, droughts, wildfires and rapidly intensifying tropical cyclones caused misery and mayhem, upending every-day life for millions and inflicting many billions of dollars in economic losses (WMO, 2024).

Regional climate models are projecting a 2-4 °C rise in average surface temperature for Belize by 2050-2080 (NCCO-NAP, 2019). A summary of the model projections for average surface temperature indicates, rainfall could decrease by 20-30% by 2050 and as much as 50- 60 percent by 2080 and sea level rise for Belize would increase by 0.32 -0,63 meters by 2080.

The SLCCL owners of the property, in particular the individual farm owners will need to be aware of these projected possible impacts of Climate Change and to take measures to adapt to these changes. Mitigation of climate change impacts will need to focus more on the prevention of burning of material and in assisting to prevent and suppress bush fires which are common during the dry season.

Emergency Management

The main natural hazards affecting the project area and which could negatively impact on the proposed agricultural activities are hurricanes, floods, droughts and bush fires. The chapter provides background information on these and has prepared draft emergency plans for these that would need to be reviewed, adjusted and operationalized by the project proponents.

CHAPTER 13 addresses **IMPACTS TO BBRS OUTSTANDING UNIVERSAL VALUES**. With respect to impacts on the OUV's of the BBRRS World Heritage Site, this assessment has found that the proposed Project will have negligible impacts on the various criterion as the project does not lie within any of the seven protected areas included in the BBRRS WHS cluster group since its location is on mainland. Although there have been some concerns on the potential impacts of land base sources of pollution to the Belize Barrier Reef System and the potential impacts associated with the runoff of agrochemicals, the impacts associated with this individual farming development is likely to be very insignificant in the scheme of things. In addition, most of the assessed impacts associated with the implementation of the project are readily mitigated with the proposed mitigation measures and best management practices.

Chapter 14 examines **Alternatives for Development**. This section of the EIA looks at the various developmental alternatives that need to be considered prior to a decision to move forward with the project. For most developmental activities there are usually two or more important developmental alternatives.

The evaluation of alternatives encompasses a wide range of economic, social, and environmental considerations associated with the various available options. This section focuses on an evaluation of alternatives to the overall proposed development inclusive of the 'No Action Alternative.' The assessment of alternatives in this chapter does not intend to repeat the individual assessments of the various alternatives for specific activities (water and energy supply, wastewater treatment etc.) which are best addressed in their respective chapters.

Assessment of Alternatives

This project was conceived as a result of the suitability of the land for agriculture cultivation using mechanized practices. The agriculture - based activities that occurred on site had resulted in the installation of most roads and infrastructure such as buildings and storage facilities as well as drainage. Therefore, the investment would take advantage of existing infrastructure to reduce costs and to reduce the need for new disturbances for the most part.

The No Action alternative would not necessarily result in the environment remaining in its present stage as the previous landowner implemented a program of phased land conversion from existing vegetation to agricultural cultivation. Therefore, in a scenario that this project did not materialize the property would still be subject to various environmental impacts including land clearing, vegetation loss, land alteration, land use changes etc. The "No Action" alternative is therefore not deemed a viable option.

Chapter 15 discusses **CUMULATIVE IMPACTS**. The chapter provides a summary of the potential cumulative impacts associated with the most important activities of the project. While this agriculture

project encompasses approximately seven thousand acres, a considerable portion of the land mass had already been under agriculture cultivation over the past. However, the impacts can be new or can be cumulative in terms of the additional environmental, social and economic effects from the present and future implementation of activities associated with the Project. Potential cumulative impacts were considered in the context of: (i) the existing environments (biologic, social and economic), (ii) stakeholder views (assessed through consultation), (iii) regulatory/industry norms (iv) planning and management.

The potential impacts associated with this proposed project have been identified based upon knowledge of the existing environment, experience with similar operations elsewhere and issues raised by stakeholders.

The relevant impacts are described in terms of their significance at the local, regional, or national level as appropriate. Potential impacts are compared looking at these impacts without control measures in comparison to the residual impacts after employing mitigation measures Best Management Practices (BMP) to address the impacts. Mitigation measures also included recommended control and management strategies proposed based on the nature of each impact.

The final aspect of the impact assessment involves describing the level of residual risk associated with each identified impact, assuming effective implementation of the proposed control and management strategies relevant to each identified impact.

Finally, **Chapter 16** provides a summary of the identified impacts and presents the recommended mitigation measures in the form of an **Environmental Management Plan and a Monitoring Plan** for the project.

A successful mitigation strategy hinges on the accurate identification of potential negative impacts and their implications, followed by the development of a comprehensive Environmental Management Plan (EMP). The proposed EMP focuses on identifying and implementing effective management tools and best practices, supported by a continuous process of monitoring and improvement. Implementing environmental management standards, adhering to best practices, and following established protocols are crucial in reducing environmental impacts, as measured by objective criteria. Consequently, the environmental management plan for the proposed project and its supporting activities involves the close integration of the following two components:

1.Environmental Impact Mitigation Plan – Impact mitigation is the most critical component of the environmental study process. It aims to prevent adverse impacts from occurring and keeps those that do occur within an acceptable level.

2.Environmental Monitoring – Environmental monitoring provides information that can be used for documentation of the residual impacts that result from the construction and operational activities. This information enables accurate prediction of the associated impacts and the necessary feed- back mechanism essential in adjusting the EMP. Therefore, the monitoring system is a platform of measuring projected impacts and also in identifying unanticipated adverse impacts or sudden changes in impact trends essential in the implementation of an environmental management program based on the concept of constant improvement.

The social components of the EMP include community engagement (though conservation efforts), as well as worker's health and safety. It is intended to also provide the project management with recommendations to foster community health and to address worker's occupational health and safety related issues, while promoting sustainable development and a healthy working environment.

CHAPTER 1 PROJECT DESCRIPTION AND PLAN

1.1 Introduction

Agriculture along with the tourism industry were the largest contributors to Belize's economy but with the rapid growth of tourism and call centres, agriculture's contribution to Gross Domestic Product (GDP) has been overshadowed by these two service sectors. In 2022, the share of agriculture, forestry and fishing sectors in Belize's gross domestic product was 7.78 percent while the services sector contributed about 61.41 percent (GOB 2019). Nonetheless, agriculture and the food sector continue playing a critically important role in Belize's economic growth. ***The Covid 19 pandemic clearly brought this to light.***

The agriculture sector still represents 80% of domestic exports and directly employs 17.9% of the Belizean population playing a critical role in maintaining economic stability and in ensuring Belize's food security. The Mennonite communities have played a pivotal role in the agriculture sector and more importantly in Belize's food security efforts.

A literature review on the Mennonite communities in Belize revealed that the Mennonites in Belize, including those in Spanish Lookout, are descendants of German-speaking Anabaptists. In 1958, Mennonite families from Mexico and Canada migrated to Belize. They were drawn by the promise of fertile agricultural land and the chance to practice their faith and cultural traditions freely and peacefully. Under an agreement with the colonial government of Belize, the Mennonites were invited to establish and manage their own communities. They were granted exemptions from military service and certain taxes.

The initial families belonged to two distinct Mennonite groups: the ***Altkolonier (Old Colony)*** and the ***Klein Gemeinde (Small Church)***. The Old Colony acquired land and settled in Blue Creek and Shipyard in the Orange Walk District. Meanwhile, **the Klein Gemeinde** purchased former timber tracts in Spanish Lookout, located in the Cayo District. The Mennonites went on to create their own schools, businesses, and financial institutions. In so doing, they contributed to the local and export markets by supplying agricultural produce, thereby boosting economic activity in Belize.

The Mennonites have made a significant impact in agriculture, transforming large areas of uninhabited land into well-maintained farming communities. They have introduced innovative farming techniques and agribusiness practices to Belize, producing corn, rice, poultry, eggs, dairy products, and beverages for the local market. Additionally, the Mennonites provide essential services in timber and carpentry, ranging from furniture-making to house-building.
Spanish Lookout is recognized in Belize for its production of dairy, poultry, large and small livestock. They also grow a variety of crops, including corn, beans, and vegetables, contributing significantly to the country's food security and agricultural output. Additionally, this community is the largest importer of auto and truck parts, tires, hardware, and steel, establishing itself as a significant hub of trade in Belize.

The industries and businesses run by the Mennonites of Spanish Lookout provide significant employment opportunities for Belizeans, both within the community and in neighbouring settlements. They also contribute to skills development in agriculture, manufacturing, and trades, enhancing the workforce capabilities in Belize.

The Spanish Lookout Mennonite Community has significantly expanded their agricultural activities in new areas and are currently undertaking an additional venture to expand their agricultural efforts primarily in grain production. In January of 2022, the **Spanish Lookout Community Corporation Ltd. (SLCCL)** signed an agreement with Tiger Sandy Bay Farms Limited to purchase their property covering an area of 6719 acres, comprising of several parcels, located near Mile 31 on the George Price Highway and extending near Runaway Creek and Sibun River along the Coastal Highway.

1.2 The Property

The Tiger Sandy Bay Farms Limited land was acquired from James and Steven Downard. The land includes three different parcels adjacent to each other. See Figure 1. The property is currently being resurveyed for accuracy.

4. PSN-53531 being 5301.45 acres of land situate on the east bank of the Sibun River and known as Tiger Sandy Bay held via a Transfer Certificate of Title dated May 7,1999 Recorded as Volume 34 Folio No.1

5. PSN-53532 being 30.00 acres of land situate at Tiger Sandy Bay at Mile 33 on the Western Road, Belize District held via Deed of Conveyance dated and recorded in Deeds Book Volume 3 of 1983 at Folios 493-498
6. PSN-67382 being 1387.62 acres of land being a portion of Orange Walk and Monkey Bay Works situate on the east side of the Western Highway (now the George Price Highway (GPH) in the vicinity of Mile 32 as shown on Survey Plan by A.R. Marin and recorded at the General Registry in Belize City in Surveyor's Plan Book No.7 at Folio 83B held via an Indenture dated the April 15, 1999, and recorded in Deeds Book Volume 12 of 1999 at Folios 507-512.

Tiger Sandy Bay Farms had previously cleared much of the land which is currently in grain production by the new owners. Most of the previously cleared area was once under citrus production with many of the trees affected by citrus greening with the orchard appearing abandoned in some areas. The owners had placed the land on the real estate market as they felt they could no longer keep up the operations.

In January of 2022, the **Spanish Lookout Community Corporation Ltd. and Tiger Sandy Bay Farms Limited** signed an agreement for the land purchase. The Purchase Agreement is being provided as proof of Legal Tenure of the parcels and company documents (Appendix III). The new owners began converting most of the previously cleared and disturbed area, along with some areas under secondary forest and shrub cover into grain production.

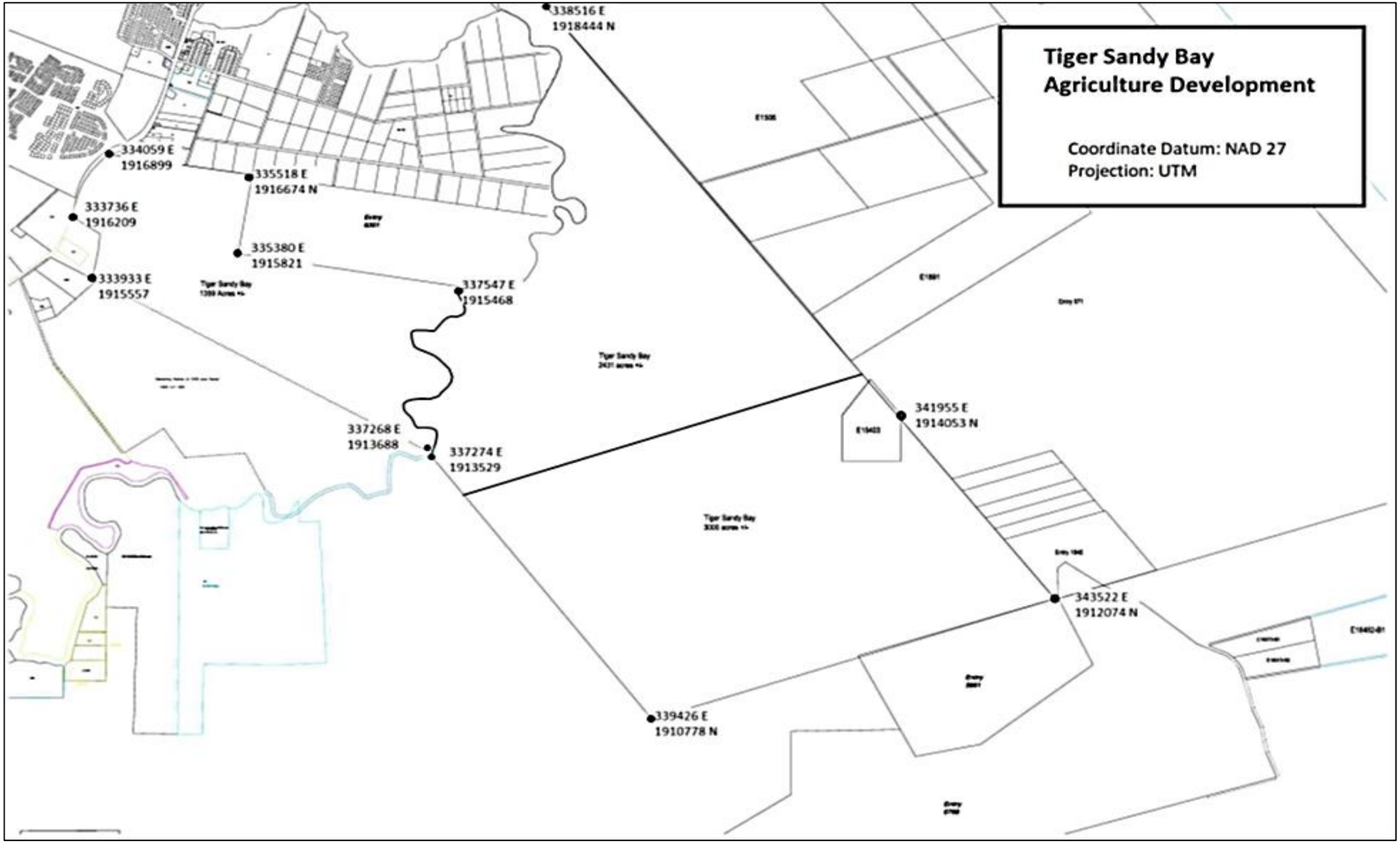


Figure 1: Tiger Sandy Bay Agricultural Development now Spanish Lookout Community Corporation Ltd.

1.3 Project Activities

The project involves the use of some 6,719 acres of land for planting crops, conservation and mining. Table 1 is a summary of the status of the land use across the property as of March 2024. The acreage under development and being considered for zoning is 6,719 acres as presented. Figure 2 is a Google map showing the location of the agriculture and mining project site, bordered to the west by the George Price Highway around the Tiger Sandy Bay entrance to the Sibun River and beyond the southern floodplain of the Sibun River running parallel to the Coastal Highway in the east to around Mile 8.

Table 1: SLCCL land use.

March 2024		
	Acreage	**Percent %**
Acres already Cleared	2751	41
Acres Bush to be Cleared	1301	19
Acres Mountains for Quarry	550	8
Acres Conservation Land	1649	25
Acres River and other Reserves	468	7
Total	**6719**	**100**

The present land use indicates that 2,751 acres (41%) of the property is cleared and being used for agriculture, mainly grains (corn, bean sorghum) with just a few citrus trees still left standing. There is 1301 acres (19%) of disturbed land with secondary growth to be further used for agriculture production, primarily grain crops. An additional 550 acres (8%) of elevated area (hilly) is being zoned and left for future quarrying activities. This area has an active Excel Quarry with non-operational Tiger Aggregates Quarry adjacent to it.

The present plan will set aside 1,649 acres, which is 25% of the land for conservation purposes or for future ecotourism development. The section of this property is also hilly and contains numerous caves (See Chapter 11) with several of them containing Mayan pottery. It borders Monkey Bay Wildlife Sanctuary and is used by them for tour guiding activities in the area. In addition, there exist 468 acres (7%) of river and water ways reserve area, inclusive of a 150 feet wide riparian reserve along the Sibun River, for a total of 32% of land to be left in reserve or for sustainable use.

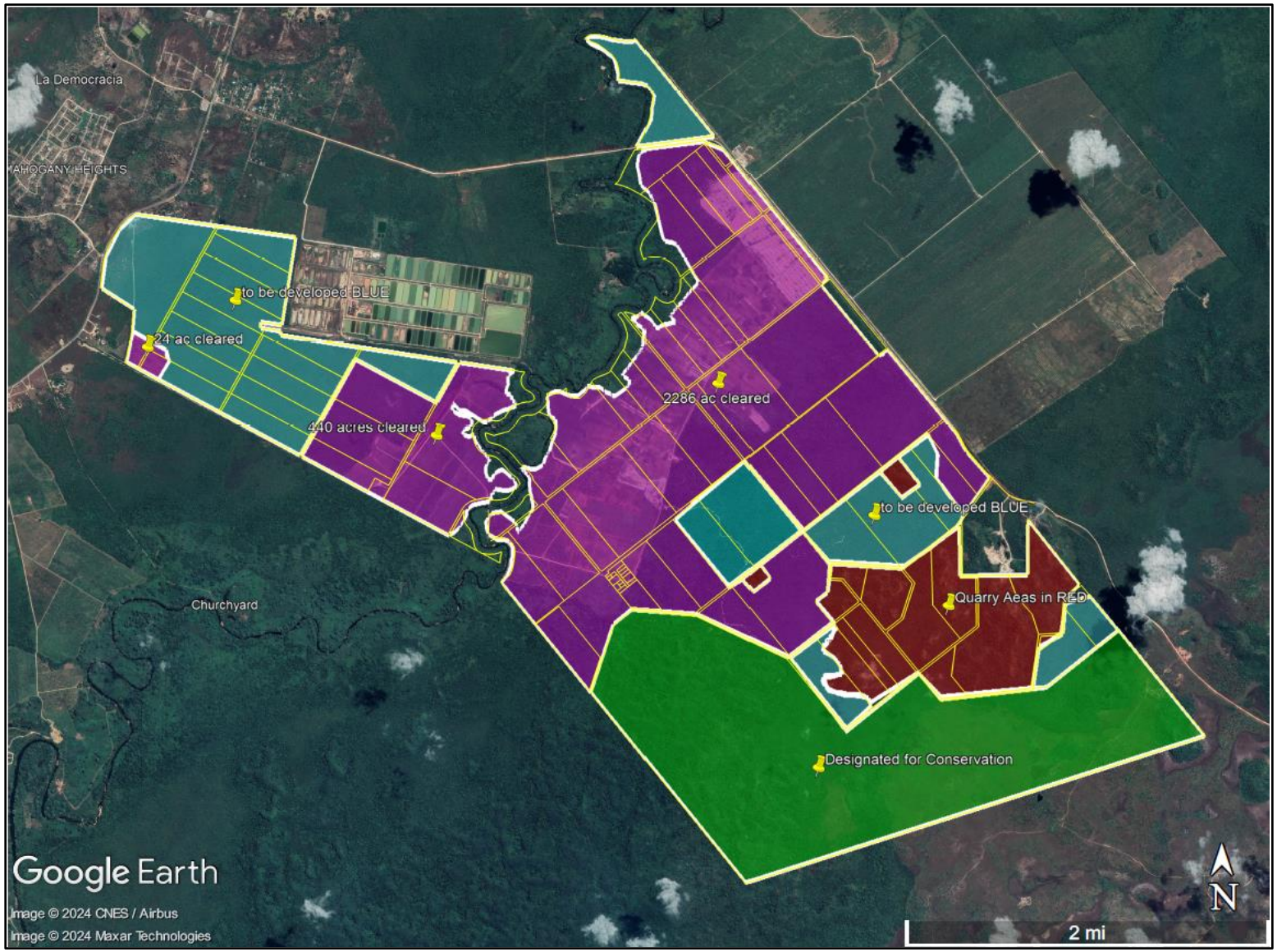


Figure 2: Project Zoning Plan.

The cleared 2,751 acres and the additional 1301 acres proposed to be used for agriculture, for a total of **4,052 acres is flat land** and lies in the Sibun River Flood plains and is best suited for agricultural purposes. These parcels are located in land systems that have been classified for agriculture production. These areas are intended to be utilized for the intensive cultivation of various crops such as corn, soybeans, sorghum and highland rice. **Farming practices of these crops are highly mechanized (Figure 3)**, with annual soil preparation, harvesting and processing for both local consumption and export.

Figure 3: Mechanized harvesting of corn.

As a socially oriented community, the development strategy for the **Spanish Lookout Community Corporation Ltd.** was to functionally subdivide the 4,052 acres among investors (producers) in the community for development and the planting of the crops of mutual interest. The present group of producers have chosen to plant grain crops (soybeans, sorghum, corn and highland rice) with some of these crops rotated. During field visits, it was observed that sorghum, soybean and corn had been planted with corn being harvested. The crops are fertilized and fumigated with little to no irrigation. SLCCL uses crop rotation to maintain previous yields or increase yield, improve nutrients and organic matter in the soil, and to help disrupt the lifecycle of crop pests, reducing chemical use.

The present 2,751 acres of land under mechanized grain cultivation using modern agricultural equipment for all phases of cultivation, from soil preparation to harvesting. **A 150 feet wide riparian reserve** has been set aside for those agricultural plots bordering the Sibun River.

To achieve optimal growth and maximum yield, the farmers intend to implement Best Management Practices (BMP). These practices have been successfully developed and implemented on other existing agricultural lands owned by the Spanish Lookout Community. By incorporating these BMPs into the project, their aim is to enhance efficiency, improve their agricultural related practices while ensuring environmental sustainability. Their aim and approach are that these Best Management Practices will lead to higher yields and greater financial success.

1.3.1 Land Clearance

The land clearance recommended for agriculture production is based on the rapid survey of the flora and fauna of the project area. The survey indicated that the commercial tree species in the present stands were small and had no timber value with hardly any salvaging value. All trees were mainly of small girth and could easily be cleared by the land clearance machinery such as bulldozers.

Most of the vegetation will be cleared using two bulldozers that are joined together with a large link metal chain between them and spaced about 50 yards apart and facing the same direction. The process is called “chaining”. The two bulldozers will synchronize their speed and proceed travelling together in parallel in the same direction. Within minutes, the chain will cover a wide swath of land and at a point, the bulldozers will turn around and begin heading back in the other direction, like a giant lawn mower with the chain as the blade. The chain has the effect of uprooting all trees and brush in its path. This method is more effective, efficient and less impacting to the soils as the bulldozer travel paths are reduced, therefore less soil compaction. Any salvageable material is then selectively pulled aside by mechanical means using a tractor and a gang of workers. Some trees will be salvaged for bush-sticks, fence posts and timber. The clearance and salvage of the vegetation would be done under a salvage license. Once this process has been completed, the remaining bush is left to dry, then burnt. The bulldozers, using a root rake, then pile the remaining burnt debris into mounds where it is re-burnt. The root rake is utilized so as to preserve the integrity of the top-soil as much as possible.

1.3.2 Crop Production and Harvesting

Once the area has been cleared, the soil is tilled and prepared for the mechanical sowing of the grain seeds. Any remaining vegetation that was not burnt is pushed in heaps and eventually mulched and left to rot after which it is reintegrated into the soil to improve its humic content.
There are a number of crops that the SLCCL has successfully produced on a consistent basis – these include beans, corn, rice and soybeans. Crops grown are often rotated from one crop to another. The farmers practice this rotation of crops in the same area across a sequence of growing seasons oftentimes times obtaining more than one crop per year increasing productivity. This practice also reduces the reliance of crops on one set of nutrients. It also reduces pest and weed pressure and the probability of developing resistant pests and weeds. This crop rotation strategy is conducted without the intervention of any inputs from irrigation. There are several countries, such as China and India, that presently utilizes the same methodology, where in some regions they depend solely on the amount of rainfall to meet their agricultural water needs. A few farmers voiced their intention to grow high-land rice that does not require any irrigation and where the planted variety is indistinguishable from low-land rice.

The land clearing equipment and those used for tilling, sowing and harvesting are brought from Spanish Lookout and other nearby areas owned by the SLCCL significantly reducing their cost of production as the rotational use of these equipment allow for their optimum utilization. Although production will rely solely on rain fed farming, for planning purposes it is recommended that the demand for water be estimated.

This method is commonly used in many countries, especially in regions and areas where water is scarce. From an environmental viewpoint it reduces the effluent stream, thus reducing the impacts of pesticides and fertilizers use on the adjacent Sibun River and from an economic viewpoint, it reduces the cost associated with pumping and water abstraction.

1.3.3 Crop Processing

There will be no processing of any crops in the proposed area. Facilities that already exist in Spanish Lookout and other areas will be utilized for the processing, packaging and storage of products from the new land under production and those remaining to go into production. The

activities proposed are those related to the clearing of the additional lands, its tilling, sowing and farming of grain crops.

1.4 Water Management

To date, most of SLCCL's grain production elsewhere, is totally dependent on rainfed farming as their crop rotation system coincides with present rainfalls. Hence, the reason why they have adopted crop rotation, and planting periods will be conducted to coincide with the rainy and dry seasons. During the dry months, or "mauga season", the SLCCL prepares the land for the next planting rotation. In this method, there is no need for water, thus no need for irrigation which also reduces overhead costs. As a bonus, there is less soil compaction.

Although SLCCL's preferred and primary method of cultivating crops will be taking advantage of the seasonal rains, SLCCL is fully aware that due to climate change, an extended drought in any given year during the delicate crop (s) growing stages can severely affect production. Hence, the option to irrigate is also considered and the decision to irrigate will be made as the need arises. ***In this case, the use of irrigation will follow the requirements set forth by the competent authorities in the abstraction of river water from the Sibun River .***

1.5 Wastewater

Based on the production methodology employed by the SLCCL, there will be minimal wastewater/effluent generated by the proposed agricultural development given that they do not intend to embark in the irrigation of crops, except in extreme circumstances where drought is jeopardizing crop production. Since there is no intention to build homesteads, all domestic wastewaters will be limited to a few bathroom facilities that could be used by farm workers. The limited volume of domestic wastewater can readily be dealt with traditional septic tanks and leach field given the large expanse of property and adjacent field have the absorptive captivity to utilize this treated effluent. However, rainwater runoff from the proposed grain field may still have the potential to lead to some contamination of the Sibun River for which the team is recommending the construction of silt traps prior to the drains being discharge into other receiving highway drains and Sibun River.

1.6 Infrastructural and Road Network Requirements

The proposed farming development located near Runaway Creek and the Sibun River along the Coastal Highway and GPH in part, near the junction of the two highways, in the La Democracia area at Mile 31 along the GPH. The proposed development is divided unequally by the Sibun River, (see Figure 4). The section north of the Sibun River has an estimated area of 1,417 acres and the section south of Sibun River has an estimated area of 5,301. acres. Both sections of the development can be accessed independently. However, there is a timber bridge that interconnects the two sections but which is inaccessible during abnormal rainy seasons, when the flood waters cause the bridge to be submerged (see Figure 5).

The proposed development plan allows for several access points to and from the GPH and Coastal Highway. There is an existing established entrance road for the transportation of farm related produce and equipment for the northern and southern section of the development. The northern section has a main access road that is a gate-controlled entrance/exit to the George Price Highway and provides access to the northernmost parcels of the development. The southern section of the development also has an existing established gate-controlled entrance/exit to the Coastal Highway and provides access to the southernmost parcels of the development. Presently only one access point on the Coastal Highway, the southern section (Main Entrance (East Side)) of the development is being used (see Figure 4).

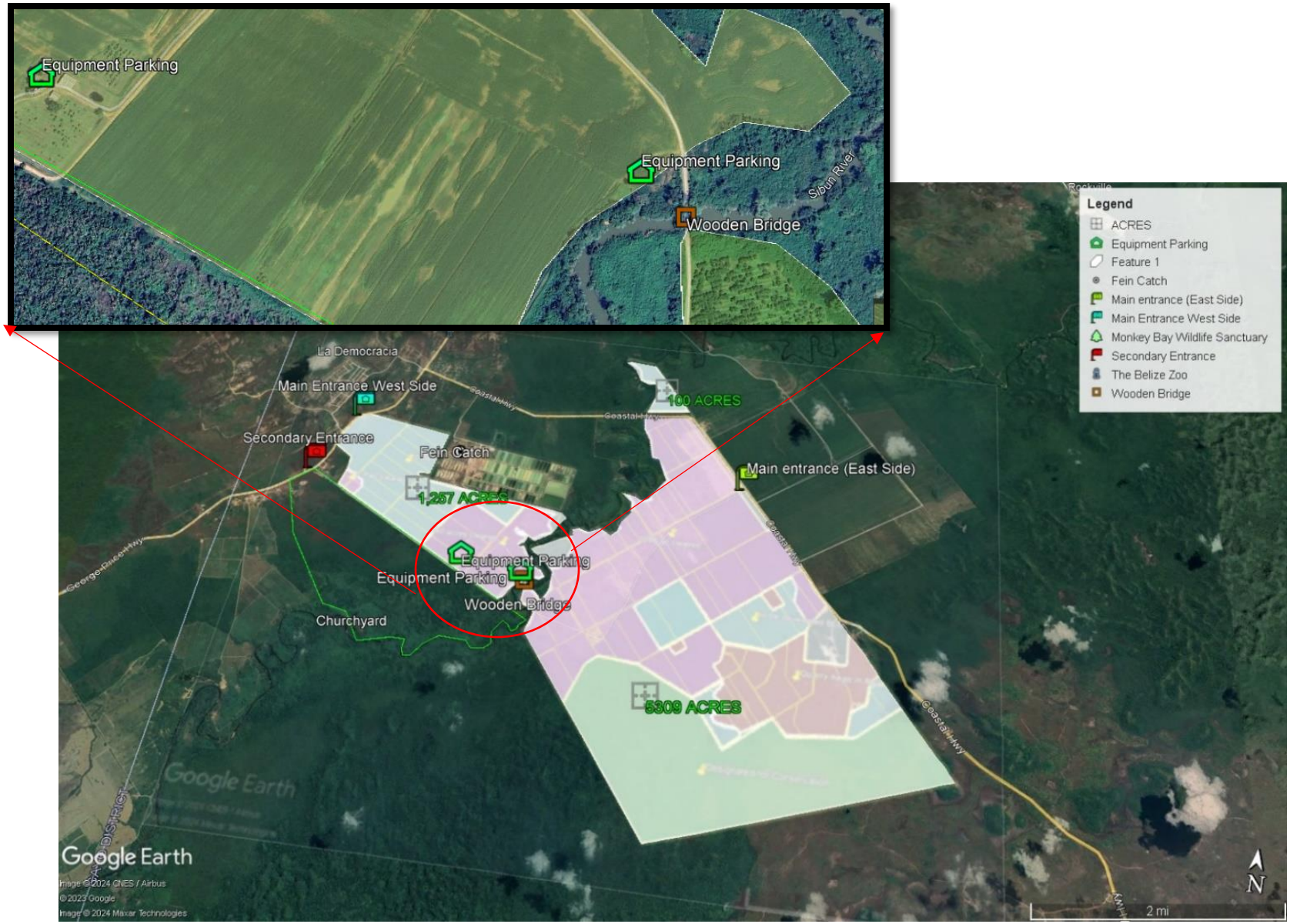


Figure 4: Proposed land development, showing acreages, access points and connecting bridge. Inset: Wooden Bridge and Equipment Parking.

Figure 5: Private wooden bridge across the Sibun River.

1.6.1 Gravel Road Network and Roadside-Drainage

The existing main gravel access roads within the development are aligned with the roads as shown on the development map (Figure 6). The assigned road reserve widths, within the development, consists of all reserves being 66 feet wide with two exceptions, these being 37 feet and 33 feet wide. The access roads can be seen on a recent image of the development, (Figure 7).

The gravel road network consists of access roads that traverses the entire development starting from the George Price Highway crossing over a timber bridge and from there proceeding onto the Coastal Plain Highway. The access roads are in conformity with the development plan to allow for the movement of the heavy agricultural equipment.

The access roads in the northern section of the development are all-weather gravel road with a carriageway width of 18 feet. The estimated length of the road in this section of the development is approximately 4 miles. The road is elevated one foot above the existing natural terrain. There are no defined drains along the road-side. The agricultural land is sloped away from the road. The gravel access road in the southern section of the development traverses the development in a south-westerly direction from the Coastal Plain Highway and coincides with the development plan for the road location an estimated distance of one mile. The estimated length of the road in this section of the development is approximately 3 miles.

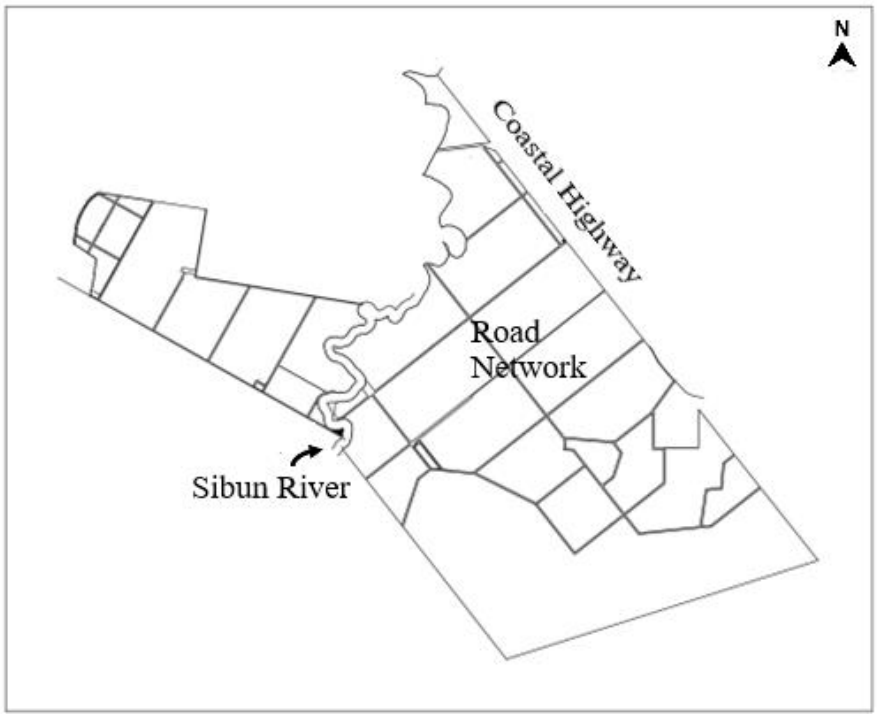


Figure 6: Roads as outlined in the proposed development plan.

Figure 7: Existing access roads in the development.

The new gravel roads in the southern section of the development are constructed in the areas designated for farming before the clearing of the land takes place. This access road is an all-weather gravel road with a carriageway width of 18 feet (see Fig.8). The recently built roadside-drains had a trapezoidal cross section with a bottom width of 4 feet, a top width of 8 feet and a depth of 3 feet-6 inches. The associated cylindrical culverts in the development are of reinforced concrete, cast iron and High-Density Polyethylene (HDPE) plastic. The culverts do not have headwalls (see Fig. 9).

Figure 8: Typical access road and side-drain within the development (newly built).

Figure 9: Typical reinforced concrete culvert, within the development.

A section of the southern development is divided by the Coastal Highway and there are no defined existing access points. The field visit conducted during the dry season revealed, that the existing condition of the road is good allowing for movement of large cargo vehicles, harvesting equipment and ploughing equipment. Potholes are a minimum along the gravel access roads.

1.6.2 Road Material Source and Volume

Within the development, the roads have been opened to varying degrees, therefore maintenance or upgrade of the internal road network is a requirement. The estimated thickness of the gravel road is 8 inches. The maintenance of the gravel road would require approximately 2,347 cubic yards of gravel per mile. Considering the overall length of the gravel road is 18 miles, an estimated 42,246 cubic yards of material would be required for the maintenance of the gravel road. The road maintenance is conducted by replenishing the displaced gravel surface or adding additional volumes for road elevation. This material is then wet and compacted as required, typically the roads are gentle sloped from the center to the sides to aide in drainage.

1.6.3 Material Source/Type

The gravel material used for both maintenance and new road construction is obtained from the Excel Quarry, which is within the proposed development which is presently in operation. Adjacent is the Tiger Aggregates Quarry which is presently not in operation. The Excel Quarry is located approximately 1.5 miles from the main entrance along the Coastal Highway.

The material obtained from this Excel Quarry found within the development in the area defined as “Quarry Areas” (see Fig. 10) is identical to the hillocks of the Tiger Aggregates Quarry (non-operational). These hillocks consist of Barton Creek massive limestone blocks which exhibit some karstification and vugs, with some clay inclusions or seams found within the infill zones. The material is quarried as an all-in unwashed crushed hardcore aggregate, and there is some screening that takes place to provide for the differentiated sizes required (see Fig.11).

Excel Quarry is capable of providing all the material requirements for the road maintenance and upgrade and new road construction. No new quarries or new quarry areas are required for the development.

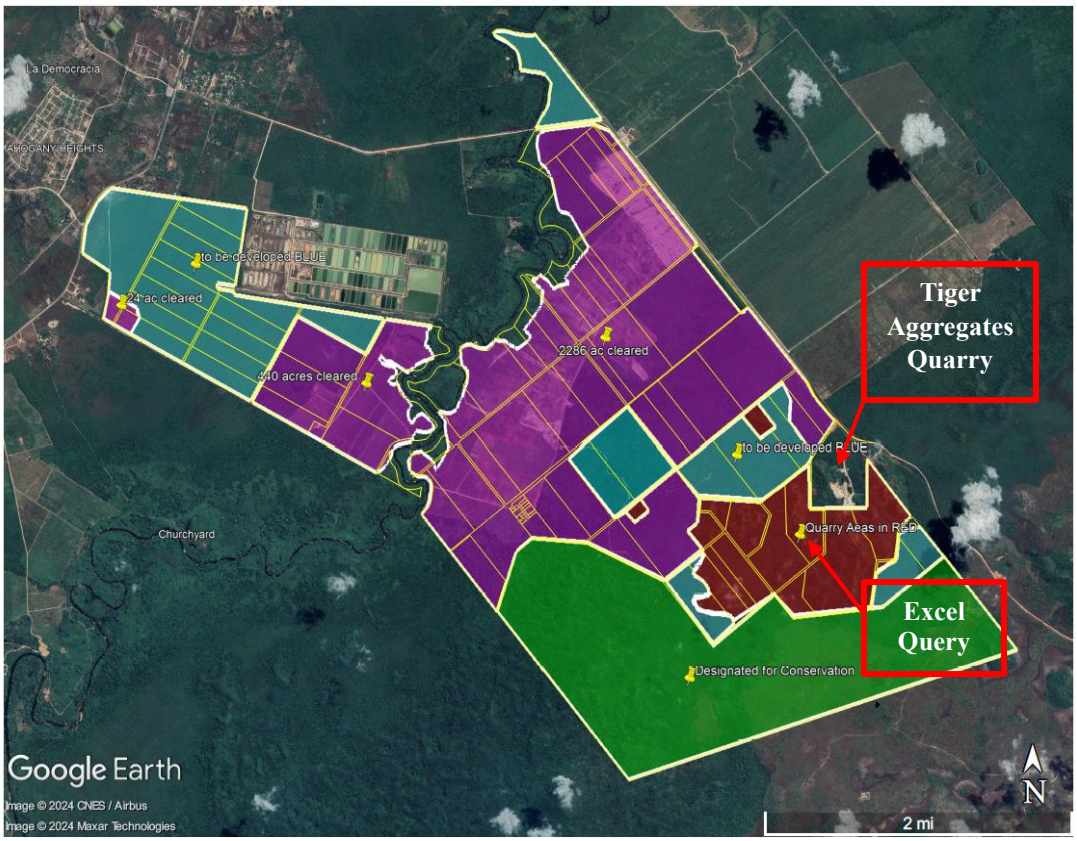


Figure 10: Location map showing location of Excel Quarry and the Tiger Aggregates Quarry.

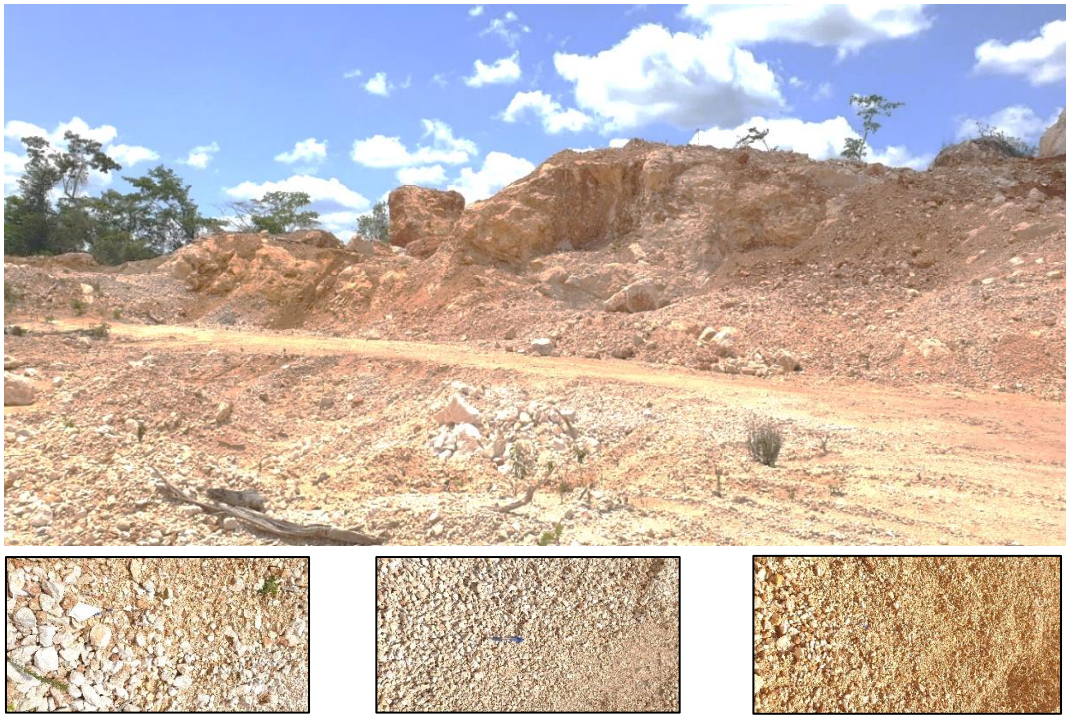


Figure 11: Excel Quarry and quarry materials for road maintenance and upgrade (6"minus, ¾" all in, unwashed 3" minus with some clay).

1.6.4 Storage Facilities

There are no plans for the construction of storage facilities to store the beans and grains being farmed. All the produce will be harvested and transported to storage facilities in Spanish Lookout.

1.6.5 Parking for Farming Equipment

There are three designated parking areas for the agricultural equipment and service vehicles. These are temporary storage since the equipment is transported to the site from Spanish Lookout on a per need basis and depending on the activity being undertaken. Two of the parking areas consist of two structures located in the southern section of the development.

1.6.6 Homesteads

No homesteads are being considered for construction in the near future. However, there are two buildings at the present entrance of the northern section of the development that are used for the housing of workers and the other for the equipment operators. These buildings are provided with potable water and appropriate liquid and solid waste disposal system.

All future buildings to be constructed within the development are to have the approval from the Central Building Authority and also approval for all electrical installations by the Public Utilities Commission.

CHAPTER 2 PHYSICAL ENVIRONMENT

2.1 Climate

The climate of Belize is tropical sub-tropical and is characterized by two main seasons: a wet season which normally commences in early June and extends to November; and a dry season which stretches from mid-February until May. A cool, moist transition period extends from late November through February, characterized by frequent frontal incursions accompanying cooler continental air masses that migrate into the NW Caribbean region and Belize.

2.1.1 Rainfall

Figure 12 is the Annual Mean Isohyetal map for Belize. The mean annual rainfall increases from the north to the south of the country, with a mean annual of about 1,400 mm (55 inches) in the northern districts to near 3,864 mm (152 inches) in the south, around the Punta Gorda Agricultural Station at 5 Miles. In the project zone within the mid reach of the Sibun River watershed (Tiger Sandy Bay – Coastal Road), the annual mean rainfall varies from around 1,963 mm (77.3 inches) to 2,032 mm (80.0 inches).

The meteorological monitoring stations nearest to the project sites are Hummingbird Citrus Limited, down the Coastal Road around Mile 5, and the Belize Zoo along the GPH. The climatic conditions at these two locations are representative of the Spanish Lookout Community Corporation Limited agriculture lands.

2.1.1.1 Hummingbird Citrus Limited (HCL2) Coastal Highway, La Democracia Village.

Figure 13 shows the monthly mean rainfall at Hummingbird Citrus Limited (HCL2) meteorological observation station on the Coastal Road near La Democracia Village. Climatic conditions at this location are representative of the climate in the Spanish Lookout Community Corporation Limited agriculture project sites in the mid Sibun River watershed and the Coastal Road. The annual rainfall regime at this location is bimodal with peak monthly rainfall in July and October, and minimum monthly rainfall in March. During the rainy period (June-November) the monthly average is in excess of 150 mm, while during the height of the dry season (February-April) mean monthly rainfall is less than 75 mm. In the cool, moist transition period, (November – February), mean monthly rainfall is less than 150 mm but greater than 50 mm, except in November when it can be near 250 mm.

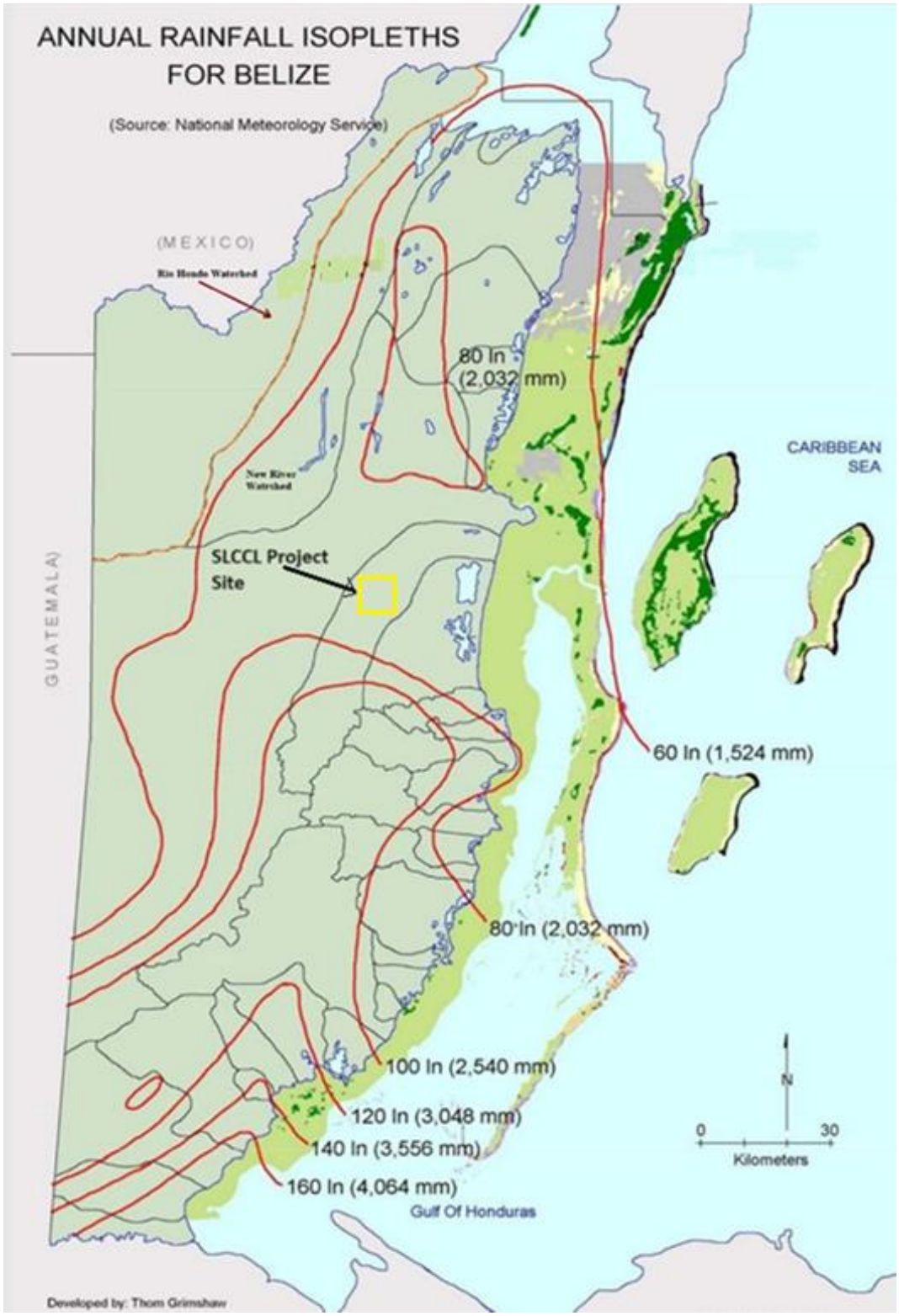


Figure 12: Mean annual rainfall (mm) in Belize.

Monthly mean maximum temperature ranges from 28 °C in December and January to near 34 °C in May, while the historic monthly minimum temperature varies from 18 °C in December and January to near 24 °C in June. The record, highest maximum temperature at the HCL2 station is 36 °C (96.8 °F).

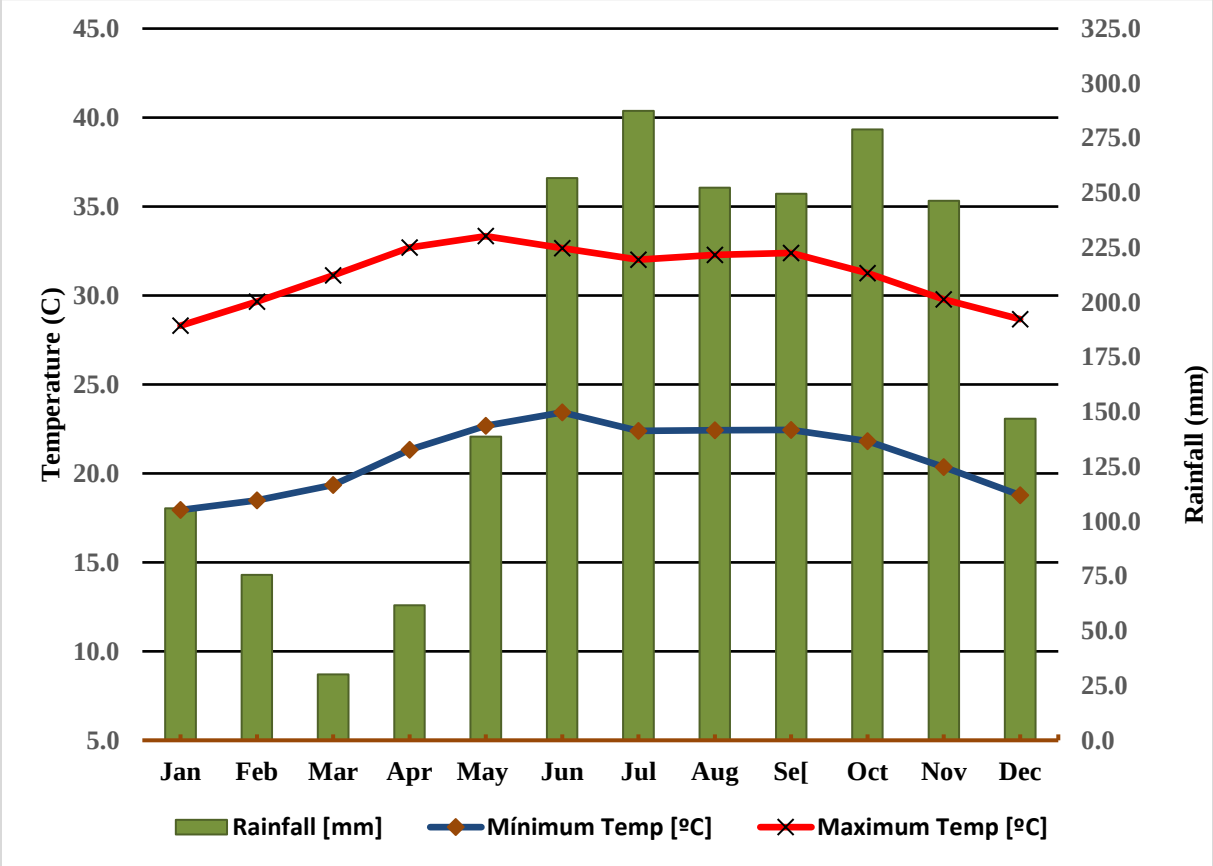


Figure 13: Monthly average rainfall and temperature (HCL2) 1993-2005 at Hummingbird Citrus Limited, La Democracia, Coastal Highway (Source: R. Frutos, 2014)

Table 2 shows the climate data for Hummingbird Citrus (HCL2) station near La Democracia Village, and the historic monthly average rainfall at the Belize Zoo. The climate variable of interest is the mean monthly Moisture Deficit shown here for the dry period months of February through May, with maximum deficits of -116.8 mm and -106.3 mm for March and April, respectively. Moisture Deficit is the algebraic sum of precipitation - evapotranspiration (P-ETP). Also, the annual mean rainfall at this location is 2,130.2 mm (83.9 inches). At the Belize Zoo, the annual mean rainfall is 1,596.5 mm.

Table 2: Monthly average minimum, maximum and mean temperature, and rainfall for Hummingbird Citrus Limited (HCL2) and the Belize Zoo.

HCL2	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean
Minimum Temp [ºC]	17.9	18.5	19.3	21.3	22.7	23.4	22.4	22.4	22.4	21.8	20.4	18.8	**21.0**
Mean Temp [ºC]	23.1	24.0	25.1	27.0	28.0	28.0	27.1	27.4	27.4	26.6	25.0	23.7	**26.0**
Maximum Temp [ºC]	28.3	29.7	31.1	32.7	33.3	32.7	32.0	32.3	32.4	31.3	29.8	28.7	**31.2**
Mean Rainfall (mm)	105.9	75.6	30.2	61.7	138.7	256.7	287.4	252.3	249.6	279.0	246.3	146.9	**2130.2**
Mean Monthly Moisture Deficit	6.9	-44.4	-116.8	-106.3	-29.3	106.7	143.4	105.3	117.6	156.0	141.3	56.9	**537.3**
BELIZE ZOO Mean Rainfall	141.7	65.6	42.6	46.6	125.5	275.2	195.2	229.7	224.5	267.5	195.8	118.8	**1596.5**

Source: Data – NMS for period 1993-2005, updated June 2024. R. Frutos, 2024.

2.1.1.2 Rainfall recorded with the AWS at La Democracia Village for January - June 2024

Table 3 shows the monthly rainfall recorded by the Automatic Weather Station (AWS) at La Democracia during the period January until June 2024. Monthly total rainfall was well below the average from February through May, as intense and hot drought conditions prevailed during the 2024 dry season. The showers returned during the first week of June and rainfall was well above the monthly normal in that area by 27th June 2024.

Table 3: Rainfall for Jan-Jun 2024 at La Democracia and HCL 2 monthly average in mm.

Democracia													**2024**
Day	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Highest	**26.8**	**8.6**	**5.6**	**4.4**	**0.0**	**283.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**56.2**
Lowest	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total	**115.2**	**10.6**	**5.6**	**7.4**	**0.0**	**632.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**771.2**
Rain days	**9**	**2**	**1**	**2**	**9**	**13**							**83**
Hummingbird Citrus Limited (HCL2)													
Average	**105.9**	**75.6**	**30.2**	**61.7**	**138.7**	**256.7**	**287.4**	**252.3**	**249.6**	**279.0**	**246.3**	**146.9**	**2130.2**

2.1.1.3 Historic Seasonal Rainfall in the SLCCL Farming Development area

Table 4 is a summary of the seasonal rainfall at several locations across central Belize and near SLCCL Farming Development Site in the mid Sibun River watershed. These include the weather observation stations at Belmopan, Hummingbird Citrus Limited (HC-2) near La Democracia, the Belize Zoo, St. Johns College Landivar, Belize City, and the main meteorological station at the Philip Goldson International Airport (PGIA) near Ladyville.

Table 4: Seasonal Rainfall statistics for key stations in the Cayo & Belize districts in the vicinity of the SLCCL.

Key Met Stations	Mean Seasonal Rainfall (mm)				Annual Mean	Percent of Mean Annual Rainfall (%)			
Cayo and Belize Districts#	DJF	MAM	JJA	SON	(mm)	DJF	MAM	JJA	SON
PGIA, Ladyville (17 mi)	383.2	225.5	662.5	737.3	2008.5	19.0	11.0	33.0	37.0
St. Johns College Landivar, Belize City (26 mi)	381.5	215.7	581.3	784.2	1962.7	19.4	11.0	29.6	40.0
Belize Zoo (2 mi)	326.1	214.7	700.0	687.7	1928.5	16.9	11.1	36.3	35.7
Hummingbird Citrus Ltd. HCL2 (15 mi)	328.4	230.5	796.4	774.8	2130.2	15.4	10.8	37.4	36.4
Belmopan (17 mi)	370.7	188.1	809.2	650.4	2018.5	18.0	9.0	40.0	32.0

Miles is the distance of the Station to SLCCL. Source: R. Frutos, 2023.

Climatologically, the seasonal rainfall at these locations is representative of the project sites, especially Hummingbird Citrus Limited on the Coastal Road near La Democracia. The record shows that the annual rainfall at this locality is near 2,130.2 mm with 37.4% of the annual rainfall occurring in JJA period and 36.4% in SON. The MAM rainfall contributes only about 11% of the annual rainfall at HCL2.

2.1.2 Surface Winds

The prevailing wind across the Caribbean and Belize is a Northeasterly to Easterly trade on the southern limits of the West Atlantic Subtropical High. The annual mean wind rose (Figure 14) generated from daily and monthly surface wind observations for 9:00 am at the Philip S. W. Goldson International Airport (PSWGIA) shows that an east-southeasterly wind is dominant 20 % of the time, followed by an easterly 16 % of the time, and a north-easterly 8% of the time.

Wind speed is generally in the range of 1 to 10 knots (with a mean of 4.9 knots), with smaller frequency of 10 to 20 knots. Historically, the maximum surface winds occurred in September (excess of 70 knots), followed by July (60 knots) for the period 1961-1996 (Source NMS, Belize). These maximum winds in September and July were associated with land-falling tropical cyclones. In the project zone (Mile 33 GPH) and in the mid to lower reach of the Sibun River watershed, the prevailing wind is from the East and Northeast with much variability in windspeed during the wet season, and Eastly to Southeasterly in the dry season. Extreme wind events of tropical storm force affect the area with land falling tropical cyclone along the country's central coast, as was the case with Hurricane Lisa in November 2022.

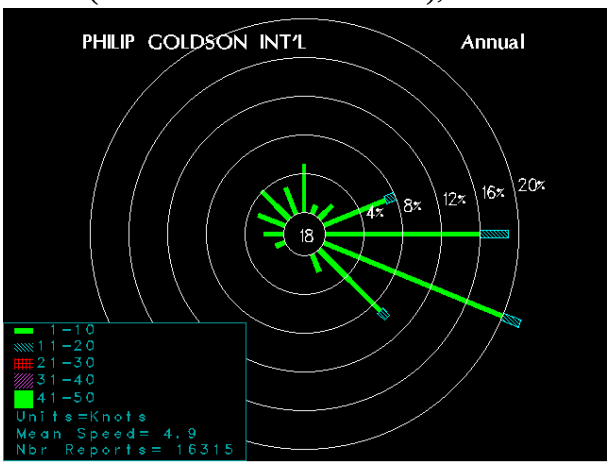


Figure 14: Annual mean wind rose for PGIA.

2.1.2.1 Belmopan

The Belmopan area experiences mild seasonal variation in average hourly wind speed over the course of the year. The windier part of the year lasts for about 6 months, from February to July, with average wind speeds of more than 3.3 mph. The windiest month of the year in Belmopan is April, with an average hourly wind speed of 3.8 miles per hour. The calmer time of year lasts for about 5 months, from August through January. The calmest month of the year in Belmopan is October, with an average hourly wind speed of 2.8 mph (NASA's MERRA-2 Modern-Era Retrospective Analysis; www.weatherspark.com).

2.1.3 Tropical cyclones and Floods

Rainfall during the rainy season in Belize is produced generally by westward moving tropical disturbances, land-falling hurricanes, and upper-level cold core lows and troughs. Northern Central America, Belize and Yucatan are in the path of Atlantic and Caribbean tropical cyclones and hurricanes from June through November.

Figure 15 is a map showing the track of recent landfalling hurricanes over and in the neighbourhood of Belize. In a normal year, the tropical Atlantic Basin can see 14 named storms, 7 hurricanes, and 3 major hurricanes. NOAA's NHC Atlantic Basin 2024 hurricane is predicting

an 85% chance of an above-normal season, a 10% chance of a near-normal season and a 5% chance of a below-normal season 2024. The Seasonal Outlook is for 17-25 named storms, 7-15 hurricanes, and 3-5 major hurricanes.

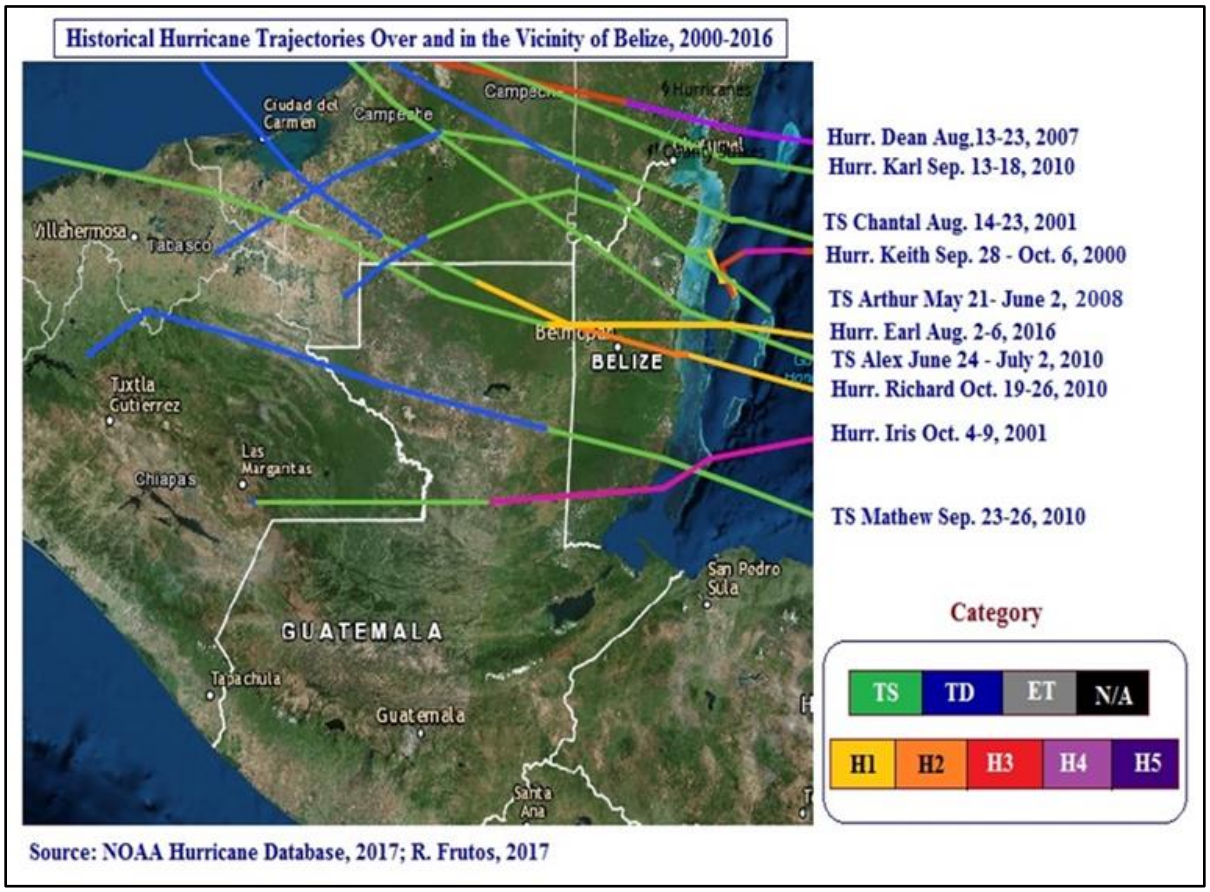


Figure 15: Map showing the track of recent hurricanes.

Table 5 is a summary of historical tropical cyclones and hurricanes that have affected some areas of Belize, and the approximate losses in millions of US dollars. The costliest storm that has impacted Belize and the SLCCL farming site in the mid-Sibun River watershed was Cat IV Hurricanes Iris of 2001 with total loss of US$ 250 million.

The record floods in Belize have been associated with landfalling tropical cyclones as was the case with TD 16 of 2008, Hurricane Keith of 2000 and Hurricane Eta of 2020. Torrential rainfall and runoff generated by these systems produced extensive flood in the Belize and Sibun Rivers, and flood the lower plain of the project site in the Tiger Sandy Bay area and Coastal Road on the approach of the Coastal Road Sibun River crossing.

Table 5: Historical tropical storms and hurricanes that affected Belize.

Name	Year	Category	Landfall (miles) from Belize City	Location	Estimated Surge m (ft)	No. persons affected	Deaths	Losses US$ Millions
No Name	1921	–	0	Direct hit	3.66 (12.0)			
No Name	1931	–	0	Belize City & Orange Walk	3.05 (10.0)		2,500	
No Name	1934	–	0	Direct hit	2.59 (8.5)			
No Name	1934	–	< 50	Moved along coast	2.44 (8.0)			
Hurricane Janet	1955	V	> 50	Corozal Town	2.44 (8.0)	> 30,000	16	>5.0
Hattie	1961	V	0	Direct hit	3.17 (12.1)	50,000	307	60.0
Fifi	1975	II	> 50	South of Placencia	3.70 (12.0)	300		0.1
Carmen	1974	IV	> 50	North of Chetumal	1.83 (6.0)	> 10,000	4	162.0
Greta	1978	II	< 50	Dangriga Town	1.8 - 2.1 (6-7)	20,000	4	0.1
Mitch	1998	V		Coast & Cayes	1.5 (4.9)	> 60,000		50.0
Hurricane Keith	2000	II	< 40	Caye Caulker and San Pedro, Ambergris Caye	1.2 (3.94)	62,570	4	227.5
Chantal	2001	TS	> 50	Northern districts				4.0
Hurricane Iris	2001	IV	< 50	Placencia	4.6 (15.1)	20,000		250.0
Hurricane Dean	2007	V	> 50	Corozal District – Mahahual, Q. Roo	2.4-3.1 (8-10)	20,000	21	148.0
Hurricane Arthur	2008	TS	< 50	Belize City	1.5 (4.9)	10,000	5	42.8
TD #16	2008	TD	> 50	Central Belize coast		38,000	5	9.9
Hurricane Richard	2010	I	< 40	Gales Point	0.91-1.52 (3-5)	15,000		17.4
Hurricane Earl	2016	I	< 40	Northern Lagoon	1.83 (6.0)	10,355		110.0
Hurricane Eta	2020	V	> 900 NE Nicaragua	Near Bluefield	4.57(15)	> 1000		50.0
Hurricane Iota	2020	IV	> 900 NE Nicaragua	Near Bluefield	3.66 (12)	>1000		30.0
Hurricane Lisa	2022	I	12	Gales Point	0.9.52 (3-5)	172,000	0	121.0

Source: R. Frutos, June 2024.

2.1.4 Droughts and Heat Waves

Extended droughts and intense heatwaves are becoming the norm as the effects of climate change becomes more evident around the world. The Caribbean region, Central America and Belize have also seen an increase in these phenomena over the past decade or two. The World Meteorological Organization (WMO) report confirmed that 2023 was the warmest year on record, with the global

average near-surface temperature at 1.45 °Celsius (with a margin of uncertainty of ± 0.12 °C) above the pre-industrial baseline.

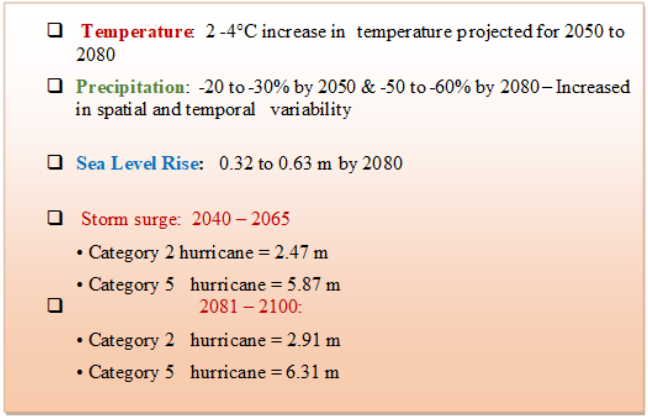
The period 2014-2023 was the warmest ten-year period on record (WMO, March 2024). Belize experienced one of the most intense dry period in 2024, compounded with several heat waves from February through May. Many areas of the country have experienced several days of day-time temperatures in excess of 100 °F /37.8 °C.

2.2 Climate Change

Human-induced climate change is already exacerbating many weather and climate extremes in every region of the world. Evidence of observed changes in extremes such as intense heatwaves, heavy precipitation, droughts, and increased frequency of major hurricane formation in hurricane basins around the world, and particularly their attributions to human influence, has become more evident since the Assessment Report 5 (AR5) of 2013 (IPCC AR6 WGI-SPM, 2021). Heatwaves, floods, droughts, wildfires and rapidly intensifying tropical cyclones caused misery and mayhem, upending every-day life for millions and inflicting many billions of dollars in economic losses (WMO, 2024).

Regional climate models are projecting a 2-4 °C rise in average surface temperature for Belize by 2050-2080 (NCCO-NAP, 2019). Figure 16 provides a summary of the model projections for average surface temperature, rainfall and sea level rise for Belize. The consequences of a 1.5 °C rise in average surface temperatures above the pre-industrial value compared with a 2.0 °C rise is significant, especially for small island and coastal states in the Caribbean region.

Table 6: Regional Climate Model Projections for Belize. Source: NCCO-NAP, 2019


Temperature: 2 -4°C increase in temperature projected for 2050 to 2080
Precipitation: -20 to -30% by 2050 & -50 to -60% by 2080 – Increased in spatial and temporal variability
Sea Level Rise: 0.32 to 0.63 m by 2080
Storm surge: 2040 – 2065
• Category 2 hurricane = 2.47 m
• Category 5 hurricane = 5.87 m
2081 – 2100:
• Category 2 hurricane = 2.91 m
• Category 5 hurricane = 6.31 m

2.3 Hydrology

2.3.1 Sibun River Watershed

The SLCCL farming development lies mostly within the lower-middle reach of the Sibun River watershed and the middle reach of the Belize River watershed further to the northwest.

The Sibun River originates at maximum elevation of 960 meters or 2,600 feet AMSL on the extreme northeastern Maya Mountains (Figure 16). These elevations are typical of the northeastern Maya Mountains, particularly within the head waters of the Caves Branch. Some 491 km^2 or 42 % of the total area of the Sibun Watershed is at or less than 40 m elevation. Low elevated section is characteristic of the Coastal Plain through which the lower Sibun River meanders to the sea. This river is well developed with a main branch, "Caves' Branch" which joins the Sibun, 33 m AMSL. This is a medium size river that rapidly descends the Maya Mountains via well-developed channels onto the coastal plains meandering to the sea. The total drainage area of the Sibun River Watershed is around 1,170 km^2.

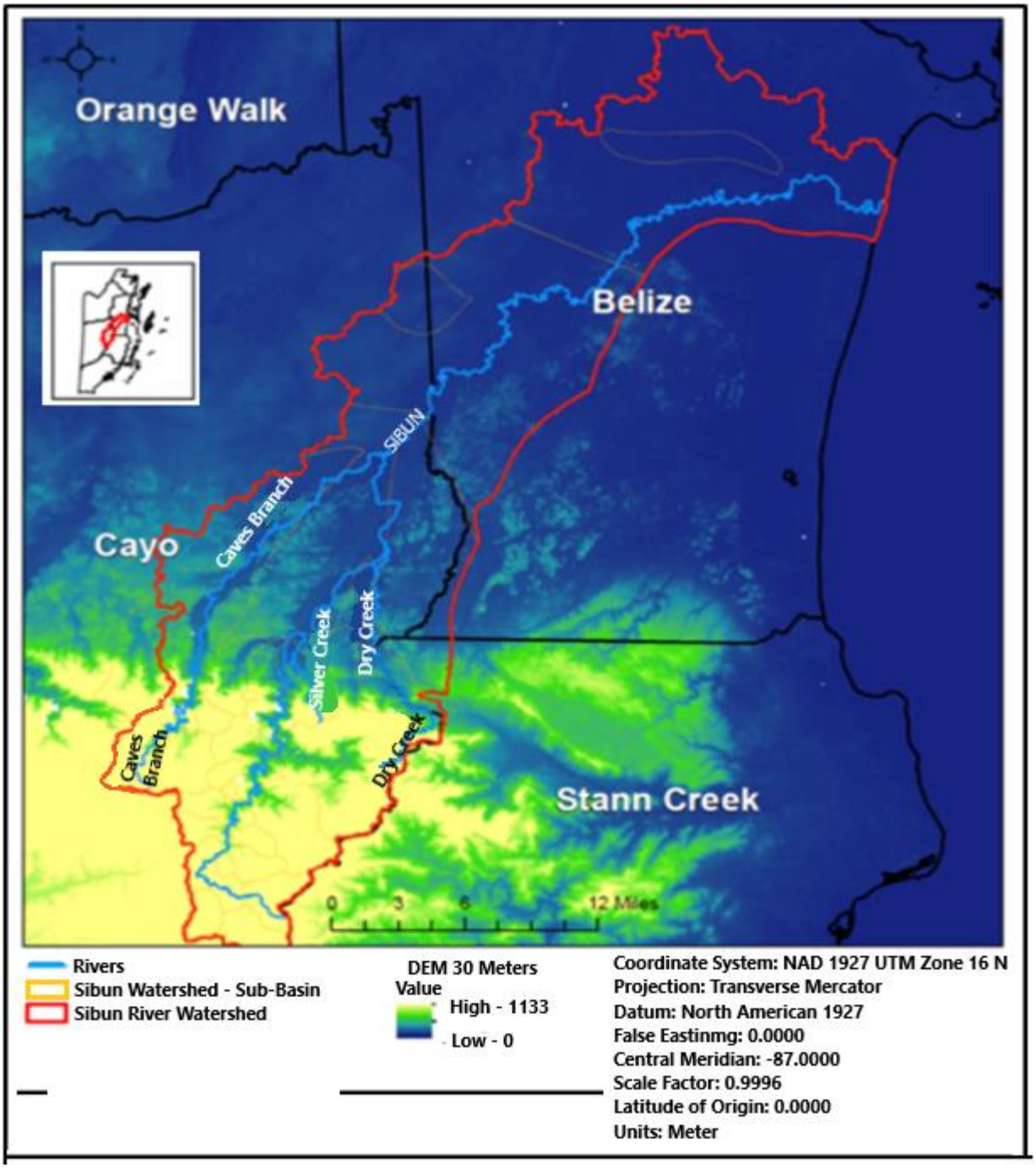


Figure 16: Digital elevation model of the Sibun River watershed and tributaries. Source: BET, 2018.

Most of the rivers that drain the eastern Maya Mountains originate at elevations of 1000 m or less AMSL. The western fringe of these basins conforms to the main divide of the Maya Mountains. The river systems are well branched and descend rapidly from the relatively short, steep slopes of the eastern Maya Mountains onto the coastal plains, where they tend to become sluggish as they

meander toward the coast. The Sibun River watershed is one of Belize's major river systems. Along with the Caves Branch River and Dry Creek, the Sibun River drains a major portion of the north-eastern section of the Maya Mountains. The river has many attributes as it winds its way from deep within the interior of the country to the mouth just south of Belize City. Though the river travels a little over 50 miles from source to mouth, the many twists and turns translates into over 100 miles of actual river channel.

Where the river leaves the mountains, farms grow a variety of crops on the wide flood plains and highly rich limestone soils. Once past the bridge on the Hummingbird Highway near Sleeping Giant Resort and Chanona's Farm, the Sibun River flows through limestone hills that are pockmarked with caves. Few recent settlements have grown along the banks of the Sibun, though development is now on the increase. The mouth of the river is constantly mined for sand.

There is evidence that the Sibun River exerts a strong influence on the regime of the Belize River. This problem occurs mainly in the area near the mouth of both rivers from the Rockville-Hattieville area along the George Price Highway to Burton Canal area near the coast, south of Belize. This wetland area with permanent mangrove lagoons fed from the Sibun River, separates the two rivers. During periods of extreme rainfall, the joining of the two rivers' flood plains creates a serious flooding problem along that stretch of the George Price Highway. Recharge for the rivers of Belize is mainly from rainfall and surface runoff during the rainy season. In the dry season the recharge is mainly from groundwater and lagoon systems. Figure 17 is a second DEM of the Sibun River Watershed showing the project site in relation to the Sibun River watershed, the GPH, and the relative elevation of the landscape.

2.3.2 Sub basins of the Sibun River

The sub-basins of the Sibun are classified in accordance with the main tributaries, namely: Sibun River sub-basin (SRSB); Dry Creek Sub-basin (SRSB5th-2); Caves Branch Sub-basin (SRSB5th-3). Figure 18 is a GIS map of the Sibun River watershed and sub-basins, and the location of the SLCCL farming development project site.

The main sub-basins in the upper and mid-reaches of the watershed are the Sibun River sub-basin itself, Caves Branch, Dry Creek and Silver Creek. Table 7 list the main sub-basins of the Sibun and Belize Rivers, estimated drainage area, elevation at origin and discharge point, the mean annual discharge, and land use.

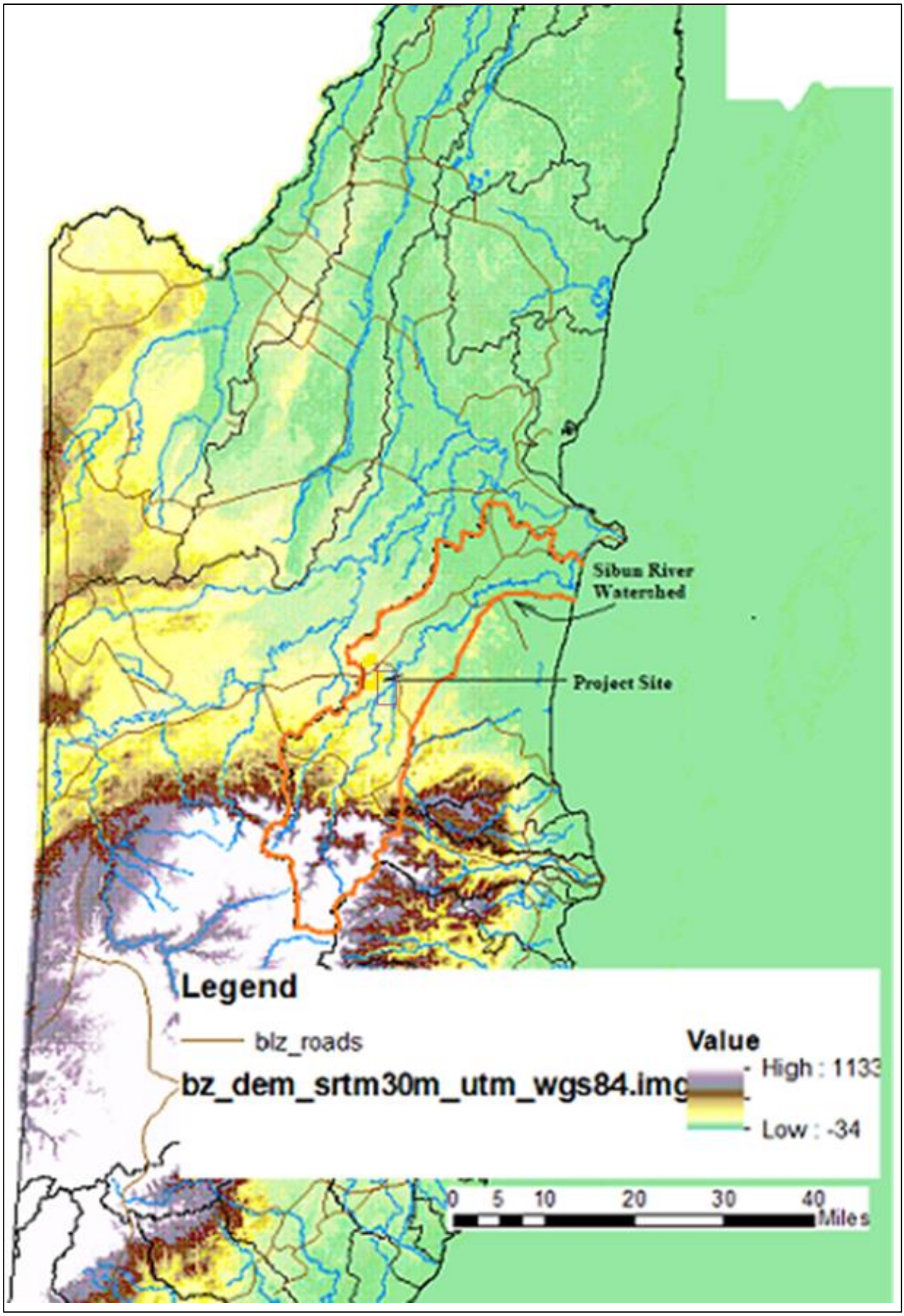


Figure 17: DEM for Sibun River watershed and the project site.

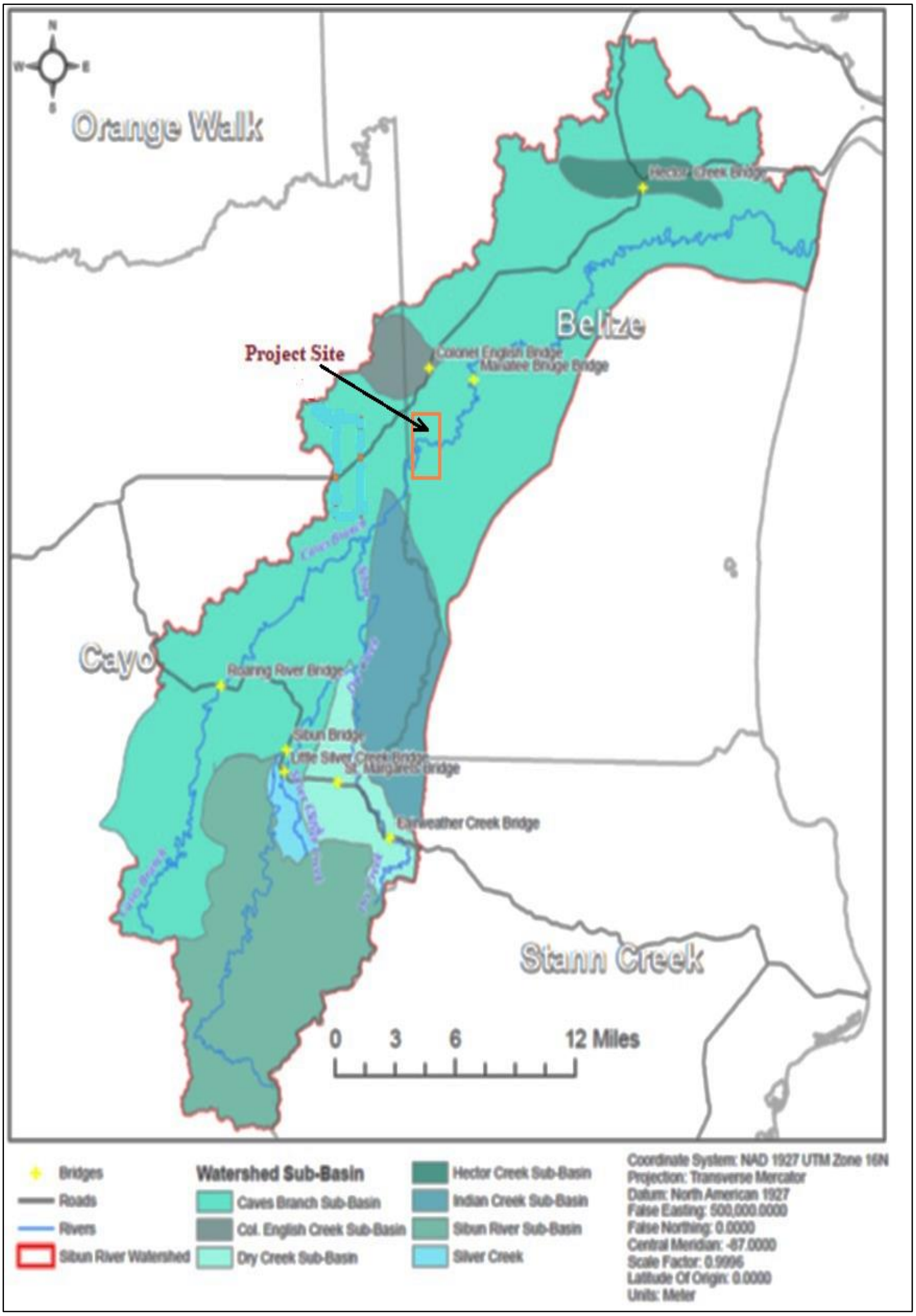


Figure 18: Sub-catchments of the Sibun River Basin and project site. BET 2018.

Table 7: Watersheds and sub-catchments of the Sibun River Basin.

Sibun River Sub-basins	Area (km^2)	Lc (km)*	H max (m)**	H min (m)***	Mean annual flow m^3/s	Land use
Main Sibun River (1)	238	160.0	960	0	45.1	Forest Reserve, citrus, pastures, mining, agriculture
Caves Branch (2)	864	54.5	800	32	15.6	Forest, mining, citrus, pasture
Dry Creek (3)	63	29.8	600	49	10.8	Citrus & pasture
Silver Creek (4)	17	21.4	500	21	12.4	Citrus, crops, pastures

* Mean length of channel; ** Maximum elevation at source; *** Minimum elevation near mouth
Source: BET-GIS, National Hydrological Department, 2013.

Table 8 is a summary of drainage area, elevation, flow and land use for the Sibun River and the Belize River watersheds. The gradient from the upper reaches to the lower reaches is much higher in the Sibun River channel, hence the flow is swifter and more energetic, but the average flow is higher in the Belize River. Recent flow discharge conducted in April 2024, show baseflow in the Sibun River of just over 3 m^3/s.

Table 8: Surface drainage area, elevation at origin discharge and land use in the Sibun River and neighbouring river basins in central Belize.

BASINS	BASIN CODE	AREA Km^2	ELEVATION AT ORIGIN m	FLOW m^3/s	AGRICULTURE LAND USE & REMARKS
Sibun River	11.01	1114.6	800 – 1000; slopes < 45 degrees	45.1	grains, citrus, pasture, pine savanna, coastal wetlands
GPS 334808 1913399**				3.59	Flow discharge at Monkey Bay, Sibun River. Dry season baseflow April 13, 2024
GPS 332953 1910868**				3.75	Flow discharge at Tiger Sandy Bay, Sibun River. Dry season baseflow April 17, 2024
Belize River	9.0	6356.7	102; slope < 1 deg.	155.0(1981-1982)	Maize, beans, pasture, vegetable, livestock, pine savanna, broadleaf forests

**** Flow discharge: Ramon Frutos & company, 2024**

2.3.3 Flow Discharge in the Sibun River and Tributaries

On April 13, 2024, flow discharges were conducted at Monkey Bay, and at Tiger Sandy Bay on April 17, 2024. As can be observed in Table 9, the flow discharge was at baseflow at both locations in the height of the intense dry season 2024. It was 3.59 m^3/s at Monkey Bay, and 3.75 m^3/s at Tiger Sandy Bay. The mean, annual flow in the Sibun River from the historical records is 45.1 m^3/s. (Table 7 above).

Table 9: Stream discharge measurements of the Sibun River and some tributaries near the project zone.

Site	Eastings m E	Northings m N	Flow (m^3/s)	Date	Remarks
Sibun River at Sleeping Giant Resort	0322401	1890290	24.8	9 Aug-18	Strong current at narrow crossing. Evidence of river rising after heavy rains in hills; by mid-afternoon, the Sibun was at about 4-5 feet above normal flood level for August
Main Creek in the Sleeping Giant Resort	0322389	1890296	0.11	9-Aug-18	Creek draining the low low-lying flood prone area of east end of orange orchard. Low flow for August
Caves Branch	0318180	1890843	5.50	24-Aug-18	Mod to low flow for Sep.
Dry Creek	0322559	1890320	3.80	28-Aug-18	Low flow
Silver Creek	0322580	1890345	3.20	28-Aug-18	Low flow
Spring Sleeping Giant Resort	0322393	1890285	0.02	28-Aug-18	Spring feed small pond and creek in the main Sleeping Giant Resort. Spring is perennial.
Sibun River (Crossing at Coastal Highway)	0338451	1917649	9.68	19-Mar-01	Discharge taken near the first bridge on Coastal Highway in dry season, March 2001
Monkey Bay	0334808	1913399	3.59	13-Apr-24	Dry Season baseflow. Dry season was intense
Tiger Sandy Bay	0332953	1910868	3.75	17-Apr-24	Dry Season baseflow. Dry season was intense
Source: Updated by R. Frutos, May 2024.					

2.3.4 Groundwater

Generally, groundwater is available throughout the less mountainous areas of Belize. In the northern half and extreme south of the country the soils have relatively high permeability and groundwater yields. Shales and slates are naturally poorly permeable; however, these sedimentary rock types may develop secondary permeability when fractured and weathered. Freshwater lens and wedges exist on the coastline and cayes.

Belize is divided into seven groundwater provinces namely the ***Campur*** province, the ***Coastal Shelf*** province, the ***Coastal plain and Shelf*** province, the ***Vaca plateau*** province, the ***Savannah*** province, the ***Maya Mountain*** province, and the ***Toledo*** province (King et al.,1992, Bukalew et

al., 1998, DOE/USAID 1996). Figure 19 is a map showing the geographic extent of the groundwater provinces of Belize as described by King, et al. (1992).

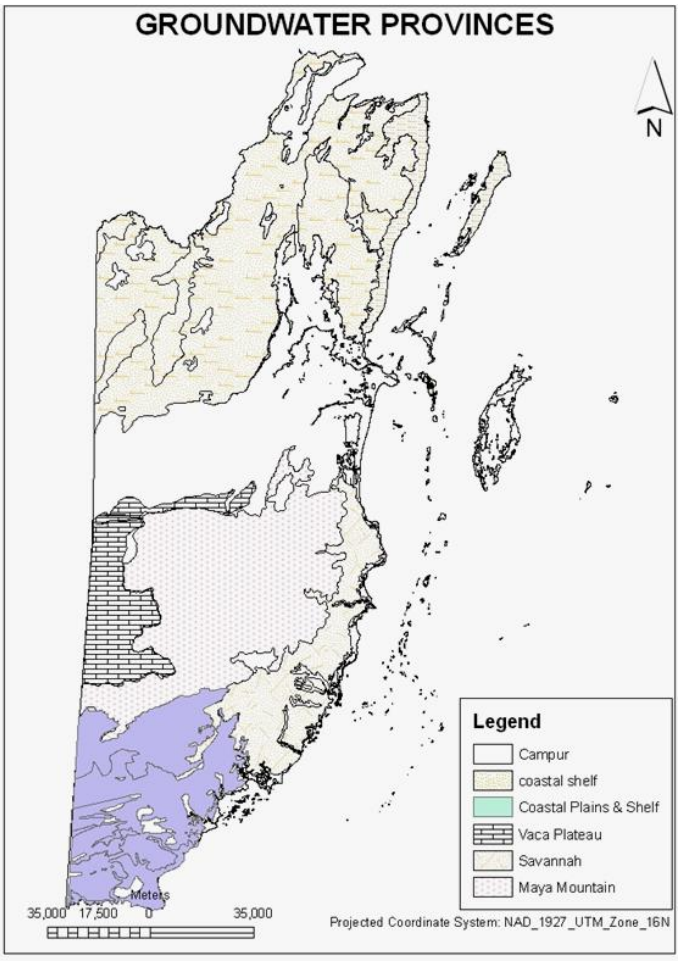


Figure 19: Groundwater provinces of Belize. King, et al. 1992.

The SLCCL agriculture development in the Sibun River – Coastal Highway flood plain lies within the Campur Province. The Campur Province coincides with the outcrop of the Campur limestone north of the Maya Mountains extending eastward to the Belmopan area and the coast, and in a northward direction to the boundary of the Coastal Plains and Shelf Provinces of the Belize, Orange Walk and Corozal districts. The area includes the northern Cayo and southern Belize districts. This Groundwater Province is characterized by semi-confined and perched aquifers primarily of quaternary alluvial deposits and Miocene-Pleistocene sedimentary materials that overlie the porous and fractured Paleocene-Eocene limestone formations. These aquifers are recharged directly from infiltration and runoff from the Maya Mountains (Santander Group (Green Tropics) EIA, 2013).

Wells drilled in the Green Tropics agriculture development and another at the Belize Sustainable Agriculture Ltd. around Cotton Tree Village produced artesian water, with the latter having a projected flow rate of over 2,000 gallons per minute (gpm) from a 20 inches production well (Tunich Nah, 2014). In the vicinity of the SLCCL farming development land, groundwater is extracted mainly for domestic use at La Democracia Village, Mahogany Heights settlement, and at Los Amigos Restaurant. However, most families in these communities use bottled water for drinking, and pond water for domestic chores and cleaning.

2.3.5 Water Resource, Demand and Use

Water use for the SLCCL farming operations will be obtained from two sources, namely: Bottled water for drinking and river and pondwater for domestic and agriculture use. The property has no groundwater production well, and none is expected to be perforated in the immediate future. Abstraction of river water from the Sibun River water may be a third source of water, but this may only be feasible for people with parcels nearer to the Sibun River. The map for the project site shows that farmlands in the flood plain are at a distance of < 1 miles away from the Sibun River, but there are no immediate plans for irrigation of these farmlands. During the field trip to the SLCCL farming development site in April and May 2024, several artificial ponds resulting from mining of fill material had substantial impounded water. It was concluded that these ponds were being recharged from upwelling groundwater.

Wells in the inland semi-confined aquifers penetrate to depths up to 150 metres with static levels rising to 26 metres below the surface. In the coastal alluvium deposits, wells penetrate to a maximum of 32 metres with static water levels rising to near 2 metres below the surface. Confined aquifers were identified at 158 metres in the northeastern portion of this Province.

Maximum inland well yields in the Campur Province are near 1,125 L/min with average hardness of 286 mg/L while in the coastal region maximum yields are near 4,000 L/min (Buckalew *et al*., 1998). Hardness is a measure of the concentration of calcium and magnesium. The deeper confined aquifer yielded 19,600 L/min of brackish water and coincides with the outcrop of the Campur limestone to the north of the Maya Mountains. Springs are common near Benque Viejo and eastward to Belmopan. Wells less than 150 m (450-ft) in depth should find plentiful water supplies from the limestone (PAHO/WHO, 1995; Bukalew et al., 1998). Groundwater of good quality should be abundant in the farming area of the Spanish Lookout Community Corporation lands in the mid Sibun River watershed floodplain. Note that there were no perforated well in the farming development lands.

2.3.6 Climate Change and Impact on Water Resources

Climate Change and climate variability will impact rural settlements and agriculture systems and practices such as soil fertility and land preparation; pest and disease control; and water requirements (moisture excess and deficits). Heat waves with daytime maximum temperatures in excess of 38°C/100 °F will cause increased stress on people and current livestock breeds, and crop types and varieties. Climate change and climate variability will highly likely result in less rainfall overall, but the most detrimental effect is likely to come from the variation in the seasonal distribution of rainfall, leading to more periodic heat waves, droughts, loss of soil fertility, soil desiccation and destructive flash flood events.

The results of the analysis on climatic trends and future climate model projections for the western Caribbean region, including Belize, indicated that over the past 50 years temperatures have been rising steadily and are projected to continue along this trend. Rainfall variability has increased as noted in the transition period from dry to rainy season in 2023 and 2024 in Belize. Climate models results indicate that this will likely become more pronounced in the future (IPCC, 2021). Increases in seasonal evapotranspiration rates have been noted over the recent past, while significant decrease in wet season moisture surpluses is foreseen. Global sea levels have risen over the past 130 years and are forecast to continue rising at the rate of 3 to 6 mm /year in the next decade (IPCC, 2021).

Analysis of Climate Change projections suggested that, under the A2 scenario (worst case) Belize will experience temperature increases of near 2 °C by the 2050s and almost 4 °C by the 2080s, relative to the baseline period 1961-1990. The Regional Climate Models (RCM) projections for 2050 show percent change in rainfall in the order of 20% to 30% from the reference period 1961-1990 under the A2 scenario, and around 50% to 60% change from normal by 2080. These conditions will be the results of more extended and intense agricultural and hydrological droughts and heat wave events.

In a recent climate modelling study, Cherrington et al. (2014) examined 13 latest-generation downscaled global climate models (GCMs) to see the effects of climate change, land use change

and runoff for watersheds in Belize for the year 2050. The study showed that the potential change in rainfall patterns will range from 24.9% below the historical norm to 23.7% above the historical norm, with an average of 7.6% below the historical norm. Additionally, for 2050, the land use change scenarios indicate potential declines in forest cover across the entire geographic domain of 1.3% in a best-case scenario, to 22.6% in a worst-case scenario – relative to 2010 forest cover. Intersecting land use change scenarios with select climate change scenarios (5 of 19), showed results for the Belize/Sibun Rivers – the most populated watersheds – with increased deforestation, with runoff potentially increasing by 85.2% (under a slightly wetter climate) or, conversely, decrease by 12.1% (under a drier climate), whereas with decreased deforestation, runoff could potentially decrease by 40.4% (under a drier climate), or increase by 37.1% (under a slightly wetter climate).

These projections into the future highlight the possible effects Global Warming will have on the environment, exacerbated by anthropogenic activities. The effects of increased climate variability and extreme climatic conditions will put additional stress on the SLCCL development, which is the rainfed agriculture cropping systems in the medium and long term.

The project will develop some 6,719 acres of land for planting crops and mining. Figure 1 is a Google map showing the location of the agriculture and mining project site, bordered to the west by the George Price Highway around the Tiger Sandy Bay entrance to the Sibun River and beyond the southern floodplain of the Sibun River running parallel to the Coastal Road in the east to around Mile 8.

2.4 Regional Geology

The development spans over three different geological groups, Cretaceous Undifferentiated Limestones, Barton Creek Formation; Late Tertiary/ Mio-Pliocene "Red Bank Group", clays and sands; and Quaternary alluvial deposits (see Figure 20 and Table 10).

The Undifferentiated Cretaceous Barton Creek Limestones located in the "quarry area" in the south-eastern sections of the development, are massive, un-bedded limestones with some vugs and karstification, often with clay filled seams.

The Late Tertiary/Mio-Pliocene Red Bank Group are benthonic variegated mottled clays, gypsum, sands chert, chalcedony, fossiliferous beds with echinoid spines, barnacles, bivalves, gastropods, crab claws, dish scales and bones. The clays and silica are likely derived from the weathering of volcanic ashes.

The Quaternary Alluvium deposits consist of river terraces, sand bars and over wash flood deposits of sands, silts and muds.

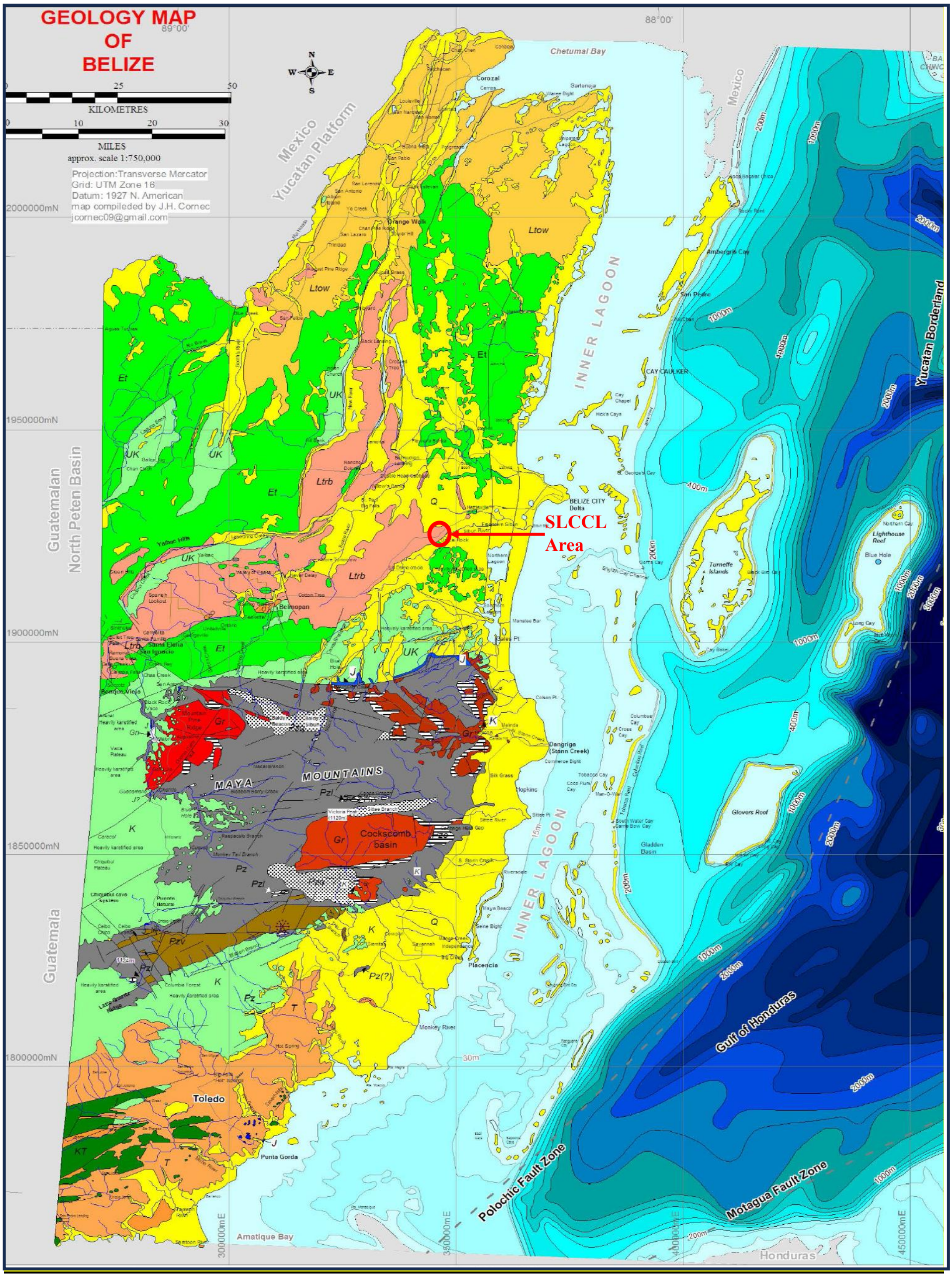


Figure 20: Geological Map of Belize, showing Development Area (Cornec, 2010).

Table 10: Geological Map od Belize – Development Area Map Legend.

GEOLOGY MAP LEGEND

Time
In millions of years (mA)

SLCCL Area

Present

Quaternary: Alluvium, river terraces, sand bars, chert/quartz gravel terraces (Iguana creek, Billy Wight, Santa Familia, incl. transparent quartz crystal pebbles) along , modern reef, calcareous sand and mud. Volcanic ash falls.

Q — Note: Holocene karstification of outcropping Cretaceous & Lower Tertiary carbonates covers about 20% of the mainland and has produced spectacular features such as a natural arch and many perfectly circular sink-holes with 300' vertical walls. The 480' deep Blue Hole at Lighthouse Reef is the largest submarine sinkhole in the world. Nearly 160 miles of cave passages have been surveyed both onshore and offshore. The Chiquibul cave complex is 60 miles long with a vertical relief of 1000', and includes the 12-acre cathedral-like Belize chamber. Fresh water artesian flows occur at many locations including Southern Lagoon area, Ambergris Caye, Rancho Dolores, NE of Belmopan and Consejo.

1.66 mA

Late Tertiary/Mio-Pliocene:

Ltow / Ltrb — Orange Walk Group: marls, micritic, coral and coquinal limestones (with corals, gastropods, oysters, pelecypods, fish scales, echinoid spines and chara seeds), gypsum, (clay, sand).
Red Bank Group: (bentonitic) variegated mottled clays, gypsum (& chalcedony pseudomorph), sands, chert, chalcedony. Fossiliferous beds with echinoid spines, barnacles, pelecypods, gastropods, crab claws, fish scales & bones, ray & shark teeths (incl. Megalodon charcarodon), mastodon teeth, giant ground sloth bones, petrified wood slabs up to 2 feet. Clays and silica likely derived from weathering of volcanic ashes originating from C.A.

Bf — Late Paleocene-Recent : Belize Formation (offshore): reef & mud carbonates, shales.

24 mA

O — Oligocene(?): Iguana Creek Fm: limestone-(dolomite)-chert pebble conglomerate with limey matrix, outcrops near Clarissa Falls, Iguana Creek and Belmopan.

36 mA

El — Early Tertiary: Doubloon Bank Fm : limestone with huge chert nodules (>3 feet in diameter).
El Cayo Group: lagoonal limestone & dolomite, marl, gypsum, chert nodules, (volcanic) bentonitic clay.

T — Late Cretaceous-Early Tertiary: Toledo Fm (Sepur Fm Eq.) : turbidites with sandstones, conglomerates, limestones, mudstones, volcanics (Tu # 1) and volcaniclastics (Gld # 1). A likely sediment source was the Cuban volcanic arc migrating to the NNE

KT — Late Cretaceous-Early Tertiary : La Cumbre carbonate megabreccias, might be partly K-T boundary-related with a collapse of the platform paleoscarp immediately after an asteroid impacted at Chicxulub.

66 mA

K/T boundary: the presence and significance of "ballistic" sediments or impactites from the Chicxulub crater is still being debated.
note: the distinction between Upper Cretaceous and Lower Tertiary carbonates is very subtle and paleontological control is sparse.

BC / K/UK / Y1 / Y2 / Y3 / HB — Undif. Cretaceous: Barton Creek Fm, Campur Fm (BC/K/UK), Coban Fm: (rudist) limestone, dolomite, collapse breccias, (gypsum).
Subsurface in Northen Belize: Yalbac Formation (Late Cretaceous): Y1-Y2-Y3 : anhydrite-dolomite alternations.
Hill Bank Formation (Early Cretaceous): HB : dolomite-anhydrite, sandstones.

140 mA

Jurassic (?): Margaret Creek/Todos Santos Fm: "continental red beds": shales, sandstones with lignitic plant remains, usually 50-100' thick; it represents in many cases the weathered uppermost part of the basement (paleosol).

J — An exception is Patchacan # 1 with a thickness of > 550' that may indicate the presence of a nearby graben or failed rift.
Jurassic marine sediments : Late Jurassic/Tithonian (to Neocomian) pelagic carbonates outcropping in hills near Punta Gorda. Note; a 400' thick salt section encountered at a depth of 1241' in the Punta Gorda # 1 well is most likely Jurassic in age.
Salt water springs are also reported in the Temash area. The age of a 100' thick salt-anhydrite section encountered within the Late Paleocene section of the Gladden # 1 well is enigmatic.

210 mA

250 mA

Triassic : uplift/no deposition or erosion; poss. intrusions in Hummingbird-Mullins River & Cockscomb-Sapote regions.

Pennsylvanian-Permian Santa Rosa Group (note: includes units such as Pzc & Pzv that have recently been dated as older as Early Devonian)

Pz / Pzl — Pzl: carbonates : dark (blue) limestones, often crinoidal, with bivalve fragments and sometimes both solitary and colonial corals, usually thinly bedded, locally thick (Cocoa Branch, > 1500 feet, with an associated geochemical Zinc anomaly)

Pz / Pzq — Pz: argillaceous sediments : shales, phyllites, black carbonaceous argillites (pyritic/silty/cherty), turbidite sequences may include coarser units (sandstones, conglomerates)
Notes : microfolded sericite micaschists encountered in Basil Jones # 1 on Ambergris Caye.
a 150' thick section of phyllites (w. garnet) encountered in the Late Paleocene section of Gladden # 1 may represent an olistolith similar to Paleogene olistostromic units found in Cuba or a sliver of Paleozoic rocks within a thrust slice.

Pzc — Pzq: arenaceous sediments : quartzites,sandstones,conglomerates

Pzc: metamorphic (contact) rocks (?): schists, slates with contact metamorphism (?) minerals: andalusite/chiastolite, tourmaline, garnet, staurolite, (kyanite).Now assigned a Pre-Silurian age.
Some minerals such as andalusite and tourmaline may have a (Late Triassic) hydrothermal origin instead of a contact metamorphic one. Most of the plutons may be of Late Silurian age, predating the deposition of the Santa Rosa Group.

Pzv — Pzv: (sub-aerial) volcanic rocks: "Bladen Member" : lava flows and pyroclastic tuffs, rhyolitic to andesitic, volcaniclastics; locally hydrothermally altered. Now assigned an Early Devonian age.
Also small outcrop of basalt north of Cabbage Haul Gap (w. chalcopyrite). Exposures of volcanic flows and tuffs in Baldy Beacon/Sibun area.

325 mA

410 mA

Devonian : uplift/no deposition or erosion; poss. intrusions in Mountain Pine Ridge.

Late Silurian granitoid plutons (from Zircon U-Pb ages)

Gr — -Mountain Pine Ridge plutons: diorite-granodiorite, granodiorite, quartz monzonite, granite and muscovite granite. Aplite & dolerite dikes.
-Hummingbird-Mullins River plutons: two-mica granite, granodiorite and quartz monzonite. Greisens. Pegmatites w. quartz-feldspar-mica-tourmaline-(beryl). Dolerite dikes.
-Cockscomb pluton & Sapote stock: porphyritic biotite granite. Pegmatite with tourmaline-mica in stock (sediment source of sand for Placencia peninsula via South Stann Creek)
Note: fine-grained pink biotite granite has been encountered in the northern Belize subsurface in the following oil exploratory wells: Orange Walk # 1, Tower Hill # 1&2, London # 3, Rancho Creek # 1, Shipstern # 1, Remate # 1 & Patchacan # 1(?)

440 mA

>1,000 mA ?

Gn — Quartz-feldspar gneisses (cataclastic (?) rocks) of unknown age outcropping in the Macal River near Mollejon (Precambrian?/Early Paleozoic?)

Drainage
Formation boundary
Fault lines

Seismicity
Belize Earthquake Epicenters (1900-1999) with Moment Magnitude (Mw) > 3.5 (see tectonic map):
22 epicenters onshore and 40 epicenters in Belizean territorial waters, or one moderate earthquake on average every 1&1/2 years.
Belize tectonicity is also evidenced by very recent changes in river courses (Belize River recently flowing into Labouring Creek while leaving abandoned meanders), possible earthquake damage to Mayan pyramid (Xunantunich), tilted beach rocks, tilted stalactites in submerged cave (Blue Hole on Lighthouse Reef).
The Cooma Cairn fault located near the Chalillo dam is still visible despite an earlier attempt at erasing it.
The fault plane orientation parallels the present-day NNE-SSW regional maximum horizontal compressive stress axe.

Bathymetry:
15m contours in inner lagoon
200m contours in Gulf of Honduras
Note: the deepest point on the seafloor within Belize exclusive economic zone is under more than 4200 meters (or > 14,000 feet) of water depth.Note: historical tsunami data shows Gulf of Honduras being affected once a century
Sea level changes: the sea level was 120 meters lower between 18,000 and 11,000 years ago and possibly 2-3 m higher relative to present sea level about 5000 years ago.
The current rate of sea level increase is 1mm per year (or 10cm/100 years). However long-term rate of sea-level rise is projected at 5mm/year (50cm/100 years).

Topography:
The quartzitic rocks of Victoria Peak reach an elevation of 1120m (3675').
A peak with no official name is located in the SW Maya Mountains near the headwaters of Rio Ceibo Grande. It reaches 1124 m (3688').

2. 5 Land System and Drainage Density

The Spanish Lookout Community Cooperation Limited (SLCCL) agriculture land is located on the southern region of the Northern Coastal Plain (NCP)m which is characteristically flat to undulating land in Northern Belize and the Belize Valley. The boundary of the NCP and the Central Coastal Plain (CCP) is arbitrary; and is part of what was called the Central Coastal Plain in King et al. (1989) - the Belize Plain Land system (BP) – which is now considered part of the Northern Coastal Plain. In Orange Walk District, the Booth's River Escarpment forms the western boundary of the northern Coastal Plain. The drainage network is none or very low.

Mean annual rainfall ranges from 1300-2000 mm and the altitude ranges from sea-level to near 20 m, with local maxima of 40 to 50 m in the Belmopan City area. Most areas of the Northern Plain are underlain by Cenozoic limestone, with decreasing age and hardness from the south-west to the north-east. The vegetative cover over limestone is semi-deciduous broadleaf forest, with large areas of pine forest and orchard savanna over leached soils from Pleistocene alluvium or old alluvium.

The SLCCL agriculture lands forms part of the Belize Plain (BP), Lower Belize Floodplains (BF), Sascab – Bever Dam (BK) and Hard Limestone Alluvium (BX) land systems. See Figs. 21 to 23. The Belize Plain (BP) is Old Alluvium, with very low drainage density, local relief less than 5 m, and undulating plain with elevation less than 57 m. The vegetation type is open savanna and water availability is variable. Process 'Pn'. See Figs. 21 and 23 for definition. The Lower Belize Floodplains (BF) is Alluvium – Melinda soil type, with very low drainage density.

The local relief is less than 5 m with altitude is less than 30 m. It consists of high floodplain bench and high broadleaf forest and very high-water availability Process: Ad. The BK Sascab Beaver Dam has very low drainage and local relief 10 m. Altitude varies from 5-70 m, with undulating plain and low broadleaf, semi-deciduous forest with moderate water availability. Process: Pn. BX – Chacalte Quamina, hard limestone alluvium soil type, with very low drainage and local relief less than 75 m. The dominant subunit is flat alluvial plain, high broadleaf, semi-deciduous forest with many quam wood and cohune, and low water availability Process: K + Ad.

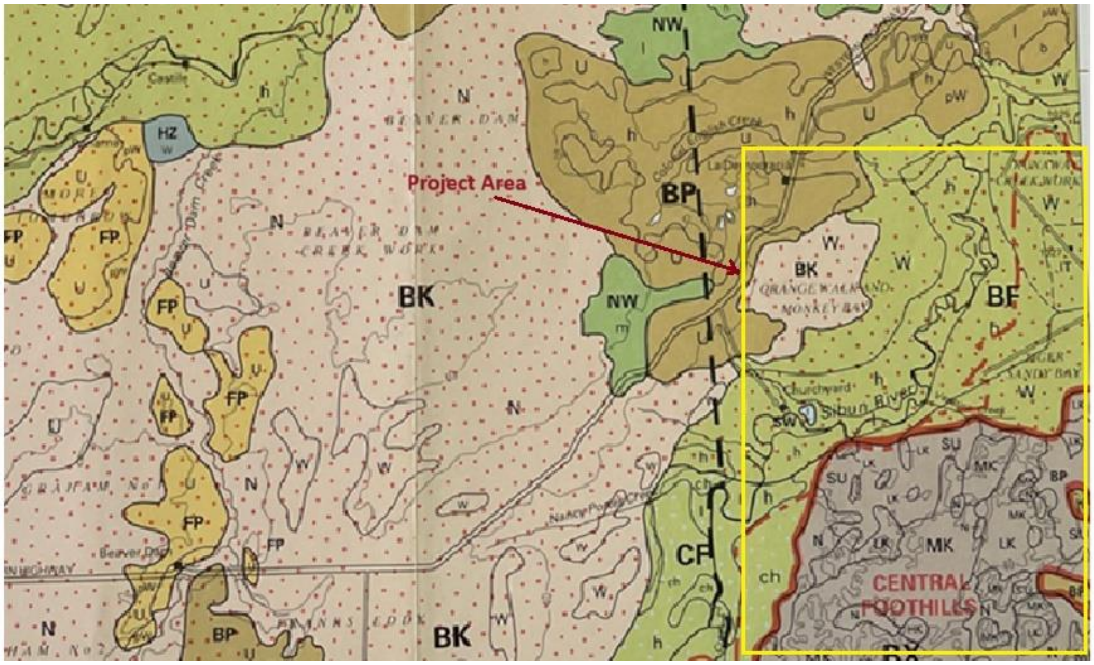


Figure 21: Land system along the GPH in the middle Sibun River watershed and the coast (King et al. 1992).

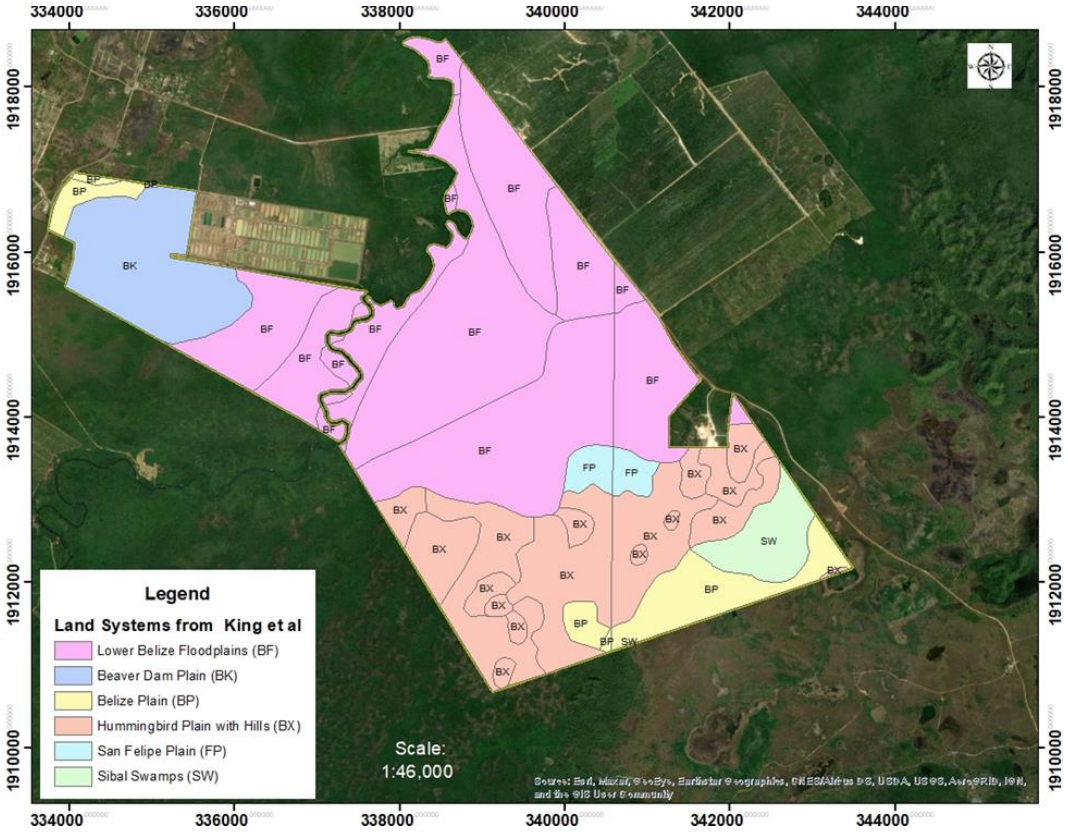


Figure 22: Land System in the Zone of Influence of the SLCCL Agriculture Lands – Middle Sibun River and the Coastal Highway.

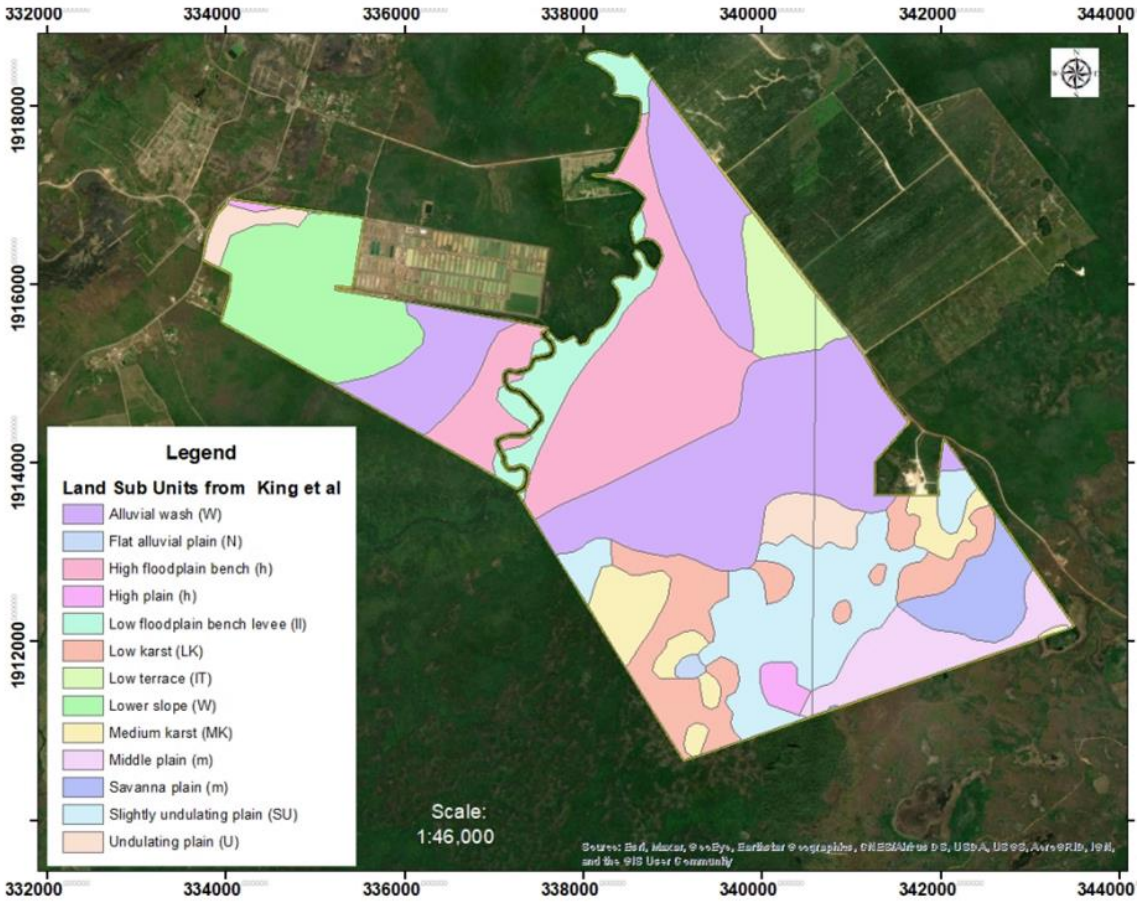


Figure 23: Land Subunits of the Project Area.

Table 11 summarizes the main land system types and drainage in the SLCCL Agriculture lands, Tiger Sandy Bay, Sibun River floodplain. A concise list of definitions and processes indicated in the Land System Table 11 is presented in Table 12 as well as other descriptions for main soil types, drainage density, local relief, dominant subunits, slope, and boundary clarity.

Table 11: Main land system types and drainage in the SLCCL Agriculture lands, Sibun River floodplain.

Land System (Belize map 1: 100,000	Dominant rock type	Process	Main soil types	Drainage density	Local relief (m)	Altitude (m)	Dominant Subunits	Characteristic vegetation	Water availability; Boundary
TY *(Tidal flat)*	Alluvium	A + M + Md	Yacos	Very low	Zero	Zero	Low tidal flat	Mangrove	Very high, BW: d TP: g, BP: a, QP: a
BP *(Belize Plain)*	Old alluvium	Pn	Boom Bocotora	Very low	< 5	<57	Pitted plain, Low plain	Open savanna	Variable, BF: c TP: d, BX: g, KP: g
KP *(Pine savanna)*	Old alluvium	Pn	Crooked Tree	Low	< 5	5-20	Undulating plain, Redeposited old alluvial wash	Pine savanna often with dense cover of tall pines and large oaks	High; QP: d HZ: c OP: d, FP: d, ZY: a
BF *(Lower Belize Flood Plains)*	Alluvium	Ad	Melinda	Very low	< 5	<10	High floodplain bench, Low floodplain bench back land	High broadleaf forest	Very high, P: c BK: g, LK: c, HZ: c
NW *(Open savanna & low marsh)*	Alluvium	Ad	Chucum	Very low	< 5	20-100	Open savanna plain, Low marsh forest plain	Variable	High, OX: a NK: a, BK: d, BP: c
BK *(Beaver Dam Plain)*	Sascab	Pn	Beaver Dam	Very low	10	5-70	Flat plain, Undulating plain	Low broadleaf semi-deciduous forest	Moderate, LK: g CK: d, BP: c OX: a, LW: g
FP *(Old alluvial wash, undulating)*	Old alluvium/ sascab	Pn	Felipe	Very low	<5	10-20	Undulating plain, Redeposited old alluvial wash	Broken pine ridge to open savanna	High, OK: d OP: g, OZ: d, KP: d
BX *(Undulating plain)*	Hard limestone Alluvium	K + Ad	Chacalte Quamina	Very low	< 75	15 - 160	Medium karst. Flat alluvial plain	High broadleaf semi-deciduous forest, with many quam wood & cohune	Low water availability TX: g, BP: g , BF: c CF: c
BZ *(Belize River Plain)*	Alluvium	Pn	BV: Butcher Burns	None	<5	<5	Flat plain	Transitional broad-leaf forest & thicket	Very high; BP: d BF: g, SW: a

Table 12: Definitions of Key Term used in Table 10 (King et al. 1992).

Process
A – Anthropogenic erosion; Ad – Alluvial deposition; F – Faulting; K – Karst; M – Marine erosion; Md – Marine deposition; Pn – Peneplanation defined as the "slow flattening of divide slopes", resulting in "multi-convex profiles" (Wooldridge and Morgan, 1959); V – Valley incision.

Other Descriptions

Drainage Density
Drainage density classification is defined with reference to King et al., (1992) stream/tributary network. Using 1:50,000 scale map the terms defined are:
Very low: < 1km/km^2; low: 1-2 km/km^2; medium: 2-4 km/km^2; high: 4-8 km/km^2; very high: > 8km/km^2.

Local Relief
Local relief is defined as the height difference between the valley bottom and the nearest adjacent intervalley crest.

Dominant subunits
The two most dominant subunits are included in the Tables, unless the second one occupies less than 10% of the area of the land system.

Slope
Slightly undulating: < 1°; undulating or gentle: 1-5 °; rolling or moderately sloping: 5-25°; steep: 25-35°; very steep: > 35°

Boundary Clarity
a. abrupt; c clear; d: diffuse; g gradational.

2.6 Topography

The development areas are relatively flat with an overall elevation variation of less than 3m across the project site. The areas in the south-east with the outcropping limestone hillocks represent the topographical highs with a maximum approximate elevation of 30m or 98ft above the relative ground level.

The clays and sands are draped around the hillocks with slightly lower elevations through the development as the Sibun River is approached throughout the property. There exist some smaller depression areas that exhibit swampy marsh areas where water accumulates. These depressions are <1m or 3.2ft lower in relative elevation.

2.6.1 Digital Elevation Map (DEM) of Project Site

The Contour map and Lidar Digital Elevation map (DEM – 1 m resolution) for the SLCCL farming lands (See Figures 24 and Figure 25), show the lowest elevations (8 – 14 m) along the banks of the meandering mid- Sibun River, with the elevation rising to 12 and 17 meters westward. From the Sibun River floodplain to the GPH, the elevation rises from around 18 m to 40 m. The elevation is higher in the karstic upthrust and hills towards the Southeast and southwest of the farmlands. The elevation rises from around 90 to 120 m in the hilly terrain in the southeastern area near the Coastal Road, and from about 54 m to 93 m in the southwestern area of the property. The elevation in the central zone south of the Sibun River varies from around 20 m to 31 m.

The local drainage direction on both side of the Sibun River is toward the lower elevations along the main channel of the Sibun River and generally east-north-eastwards along the river channel. According to the Land System Type of the general area, the drainage characteristic of the landscape is very low.

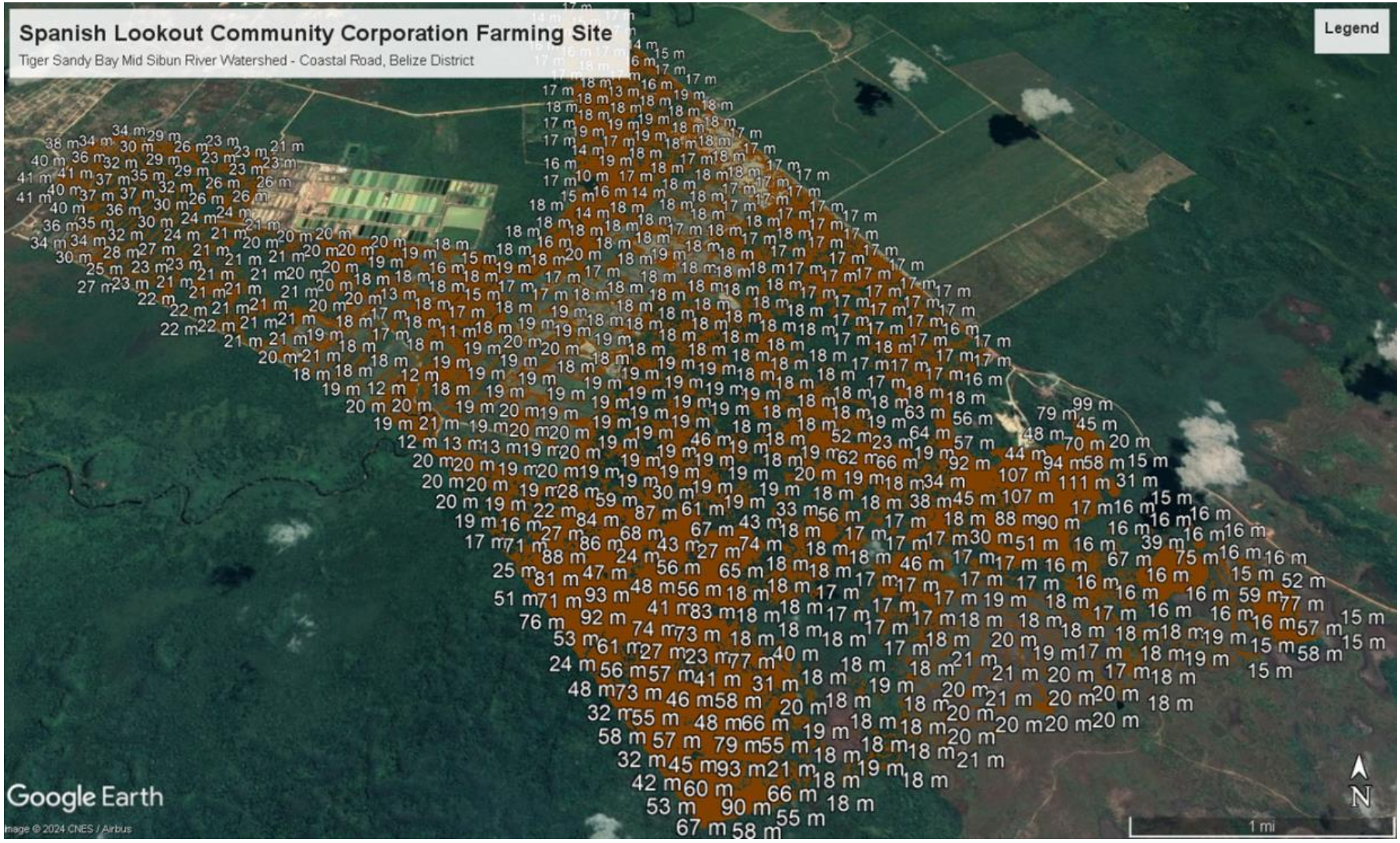

Spanish Lookout Community Corporation Farming Site
Tiger Sandy Bay Mid Sibun River Watershed - Coastal Road, Belize District
Legend
Google Earth
Image © 2024 CNES / Airbus
N
1 mi

Figure 24: SLCCL Digital elevation land map, mid Sibun River watershed, Belize District.

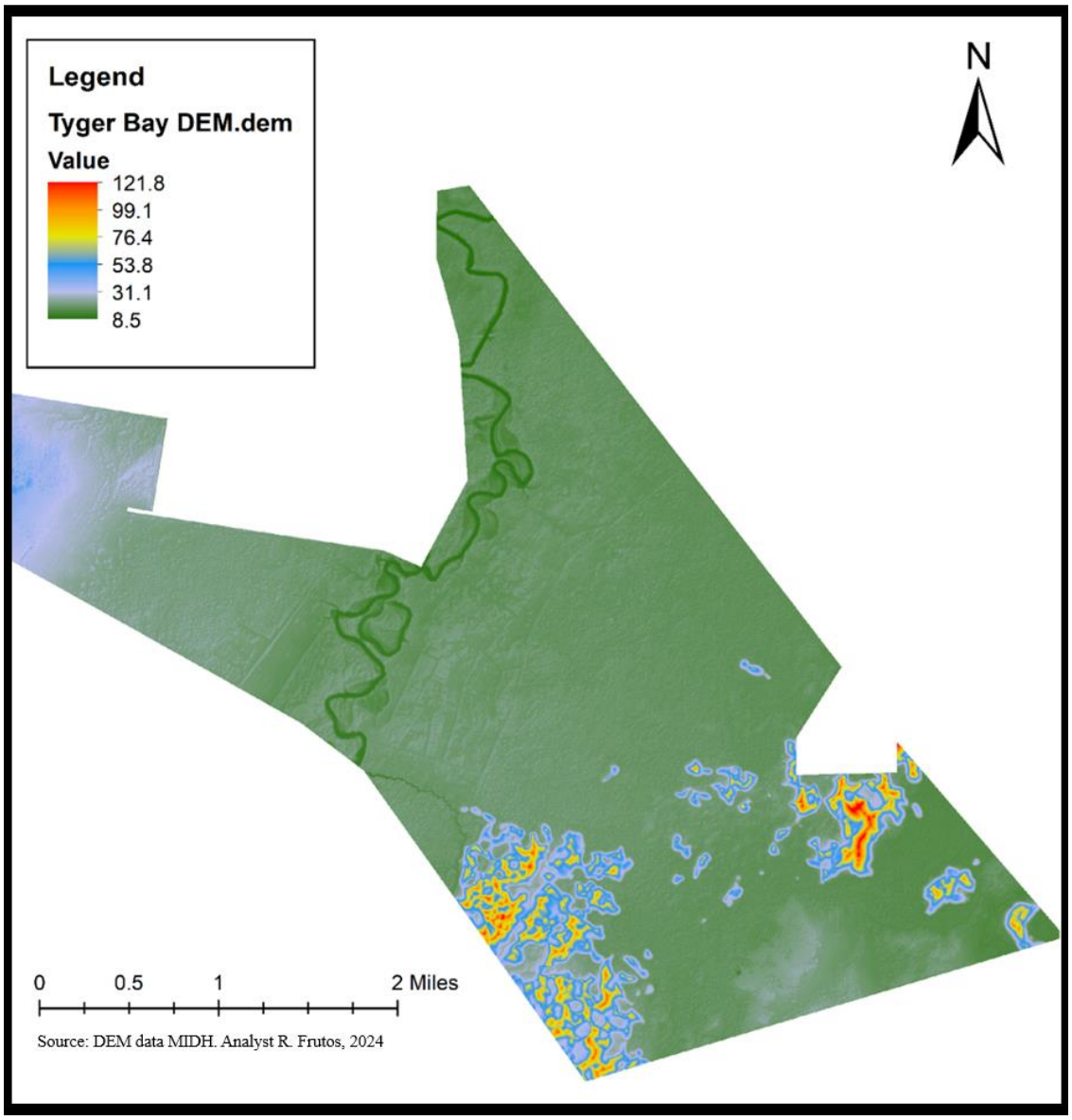


Figure 25: SLCCL Land Lidar 1 m resolution map, Belize District.

2.7 Forest Cover 1980-2010 and Main Watersheds

2.7.1 Sibun River Catchment

Figure 26 is a Belize country map showing the main watersheds and 5-year deforestation rates from 1980 to 2010. The Sibun River watershed has seen its share of deforestation during this period, particularly in the mid-reaches, where the SLCCL Agriculture development is located in the mid reach of the watershed.

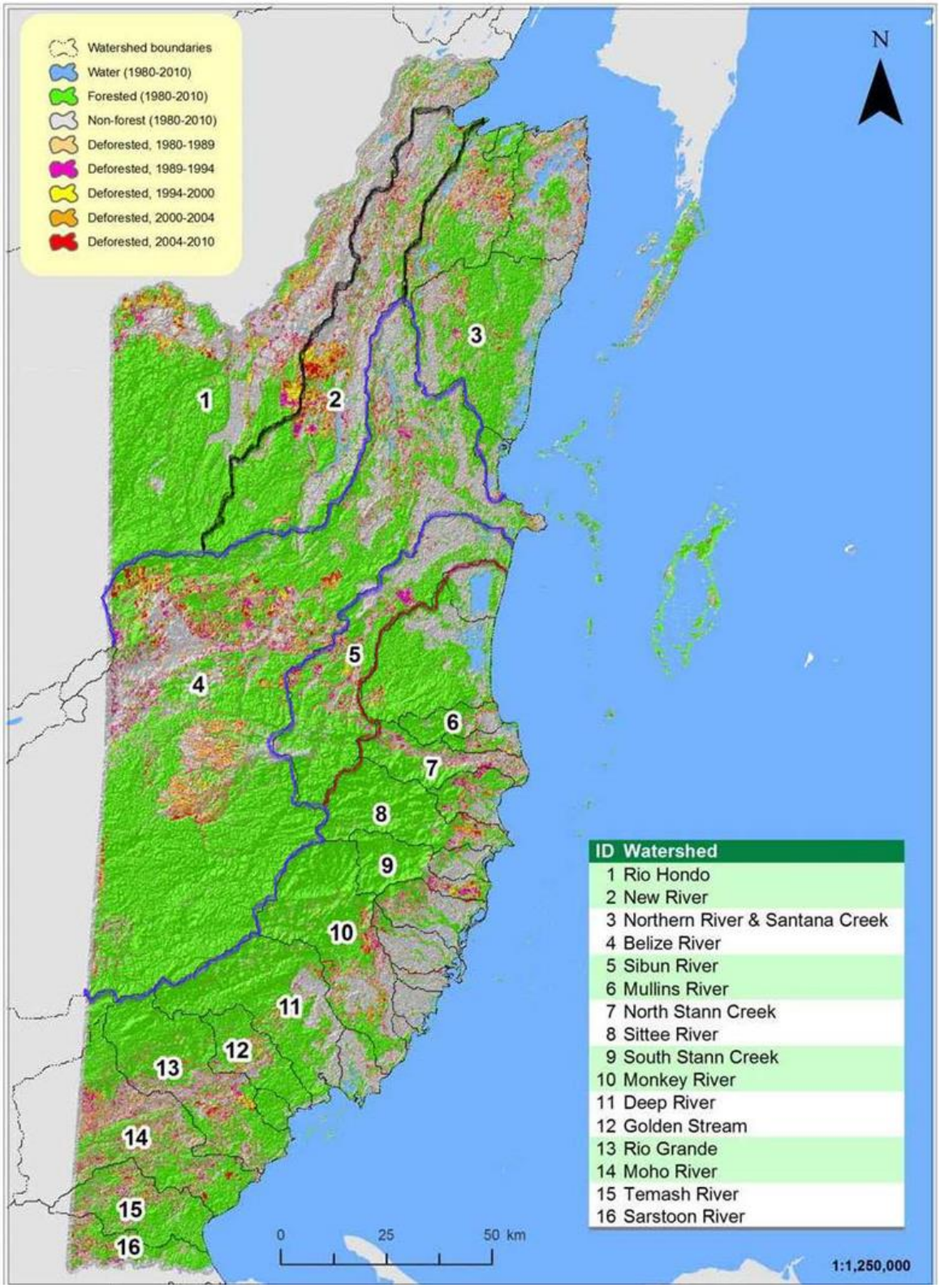


Figure 26: Forest cover and deforested areas in the main Watersheds **(Source: Cherrington, 2012).**

The majority of the Sibun River Watershed is broadleaf forest, especially above the Hummingbird Highway. The other principal vegetation types in the catchment are summarized by percentage cover of catchment in Table 13

Table 13: Major vegetation types of the Sibun River Watershed.

Vegetation Type	% of Catchment
Broadleaf forest	64.6
Savannah	11.6
Mountain Pine Ridge	9.7
Thicket	6.7
Savannah/thicket	2.4
Riparian forest	2.1
Mangrove	1.6
Scrub	1.3

(Source: Boles, 1999)

The vegetation/land use type in the upper to mid reaches of the watershed based on the 1995 Land Information Centre map, consist of: Broadleaf hill forest over limestone; Lowland Needle-leaf moist open forests over poor soil; Seasonal swamp forest (Marsh Forest) of Northern Belize, Coco Plum Variant; Fire induced vegetation and karstic Hills; Agriculture (e.g. pastures and cropland); and Urban areas.

In the mid and lower reaches of the Sibun Watershed, the main vegetation/land use types include Fire induced scrub over poor soils; Disturbed scrub; Mountain inland well-drained over poor soils; Permanent waterlogged freshwater scrub; Seasonally waterlogged scrub with abundant Miconin (Maya) species; Mixed mangrove and scrub; and Coastal beach and scrub.

Vegetative types and soils consist of the following: Lowland Broadleaf, Moist Evergreen, Seasonal Forest over limestone; Broadleaf Forest over non-calcareous rocks; and Mountain Pine Ridge.

2.8 Baseline Water Quality

2.8.1 Methodology for Water Sampling and Analysis

In situ testing of sampling sites was done using an YSI Professional Plus meter equipped with a ten - meter depth probe. The instrument was calibrated for use in freshwater environments.

Water samples were collected as follows: In situ sampling on two different dates, and on three dates at some sites, and two separate samples on two different dates were also collected for laboratory analysis. The following steps were taken for water sampling:

1) Sites were selected in order to be representative of the Sibun River within the project site and in the immediate surrounding of the proposed project site. This would allow for sampling to establish baseline conditions from which future monitoring results may be compared. The sites included two previously existing pits that were dug for the treatment and disposal of effluent from another industry.
2) Equipment for In -situ analysis was done using a YSI Professional Plus equipment that had calibrated sensors to test for temperature, pH, depth, salinity, TDS, Conductivity, Specific Conductance, Dissolved Oxygen, turbidite and atmospheric pressure. On site testing using this equipment was done by Ismael Fabro, Evaristo Avella and Ramon Frutos, (on various dates), who also collected samples for laboratory analysis.
3) Samples for laboratory analyses were taken from the same sites sampled for in situ analysis and was done using equipment supplied by the laboratory. This equipment included cooler, sample bottles, including sterile sample bottles for bacteriological sampling.
4) Water samples for laboratory analyses were collected by rinsing sample bottles three times prior to collection of samples. Samples were covered tightly and placed in the cooler with ice.
5) Samples were secured to remain upright and transported to the Bowen and Bowen Laboratory and Samples for testing of bacteriological composition were collected using sterile sample bottles supplied by the laboratory.
6) The required chain of custody form was filled for all samples which were clearly labelled, and data such as temperature, location, time of sampling, parameters to be tested and name of sample collector were then supplied to the laboratory.
7) Samples were analysed within the required holding time and the results were indicated in the laboratory form with the name and signature of the analyst.

The designated sample sites are listed in Table 14 and Fig. 27.

Table 14: Location and Coordinates of Sampling Sites.

Sampling Site	Tributary/Location	Eastings	Northings	Date Sampled	Remarks
#1	Sibun River at Monkey Bay	0334799	1913422	4/25/24	YSI probe
#2	Sibun River at Wooden Bridge	0337182	1914427	4/25/24	YSI probe
#3	Sibun River at Tiger Sandy Bay	0337145	191 4069	4/25/24	YSI probe
#4	Sibun Bridge (at Coastal Highway)	0338484	1917693	4/25/24	YSI probe
#5	*Pond #1	0339525	1915865	4/17/24	YSI probe
#6	*Pond #2	0339496	1915842	4/17/24	YSI probe
#7	** Pond with Tires	0341466	1914684	5/6/24	
#8	***Sibun River Downstream from Sibun Bridge at Coastal Rd	0338299	1918309	5/6/24	YSI probe

*These ponds (at sites 5 and 6) are existing ponds that were used for disposal of effluent and expired soft drinks some years before. Pond no. 1 displayed a darker coloration since this received the effluent and Pond No. 2 contained the overflow of pond one, which had a lighter coloration. The results reflect the high nutrients in the ponds.

** This pond is an abandoned mining pit used by the Coastal Highway project. It has some abandoned tires, and testing as part of in situ and laboratory analyses. This pond was only sampled on May 6, 2024.

*** Site number 8 was a site near the southeastern corner of the project, which is the strip of land on the opposite side of the coastal highway. It is located east of the Sibun Bridge at the Coastal Highway. This site was only sampled on May 6, 2024.

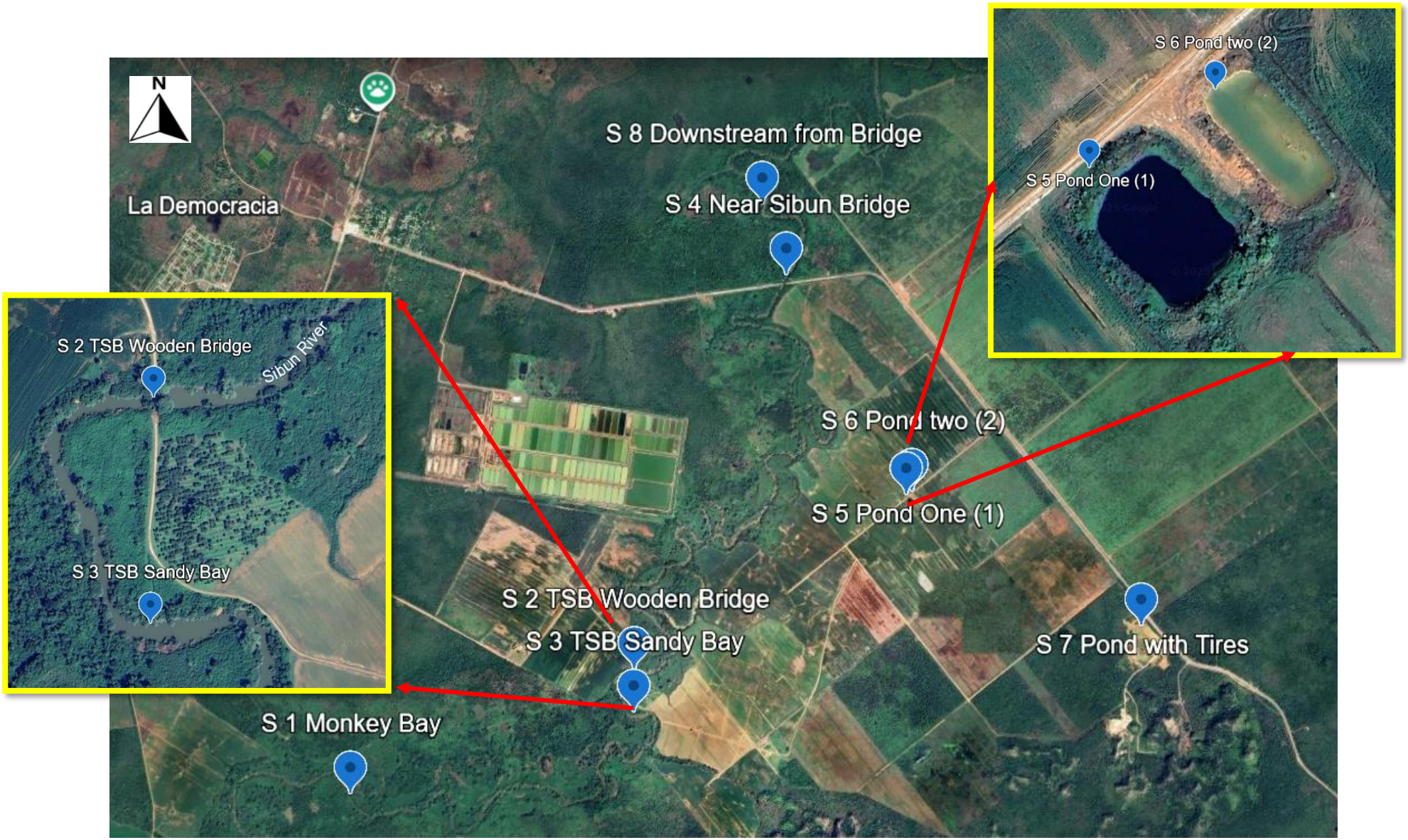

N
S 8 Downstream from Bridge
La Democracia
S 4 Near Sibun Bridge
S 6 Pond two (2)
S 5 Pond One (1)
S 2 TSB Wooden Bridge
Sibun River
S 3 TSB Sandy Bay
S 1 Monkey Bay
S 7 Pond with Tires

Figure 27: Google Map Showing location of sampling sites.

2.8.2 In Situ Water Quality Monitoring

In Situ Analysis - April 13, 2024.

On this date only two sites were sampled because these sites were visited primarily to obtain streamflow data. The in-situ Water Quality Monitoring carried out on the April 13, 2024, resulted in the following levels of key parameters (Table 15):

i. Mean water temperature was 27.6 °C

ii. Dissolved Oxygen (DO, %/L) varied from 22% at Monkey Bay to 90% at Tiger Sandy Bay (TSB), and 6.14 at Monkey Bay while showing 6.9 mg/l at TSB. These levels are very Good for Surface water in the landscape.

iii. Specific Conductivity in **µS/cm** varied from 209.2 at Monkey Bay to 206 at Tiger Sandy Bay and 76.5, respectively. This is a measure of water's ability to conduct electrical current, which is directly related to the concentration of dissolved ions in the water. It reflects the concentrations of dissolved salts (chloride, sulphate, sodium, and calcium). High specific conductivity indicates pollution from agricultural runoff, wastewater discharge, etc.

iv. Total Dissolved Solids (TDS, mg/L) were both at almost 136 mg/l at both sites.

v. Salinity was low at both sites, showing 0.10 ppt.

Note: No laboratory analysis was done for sampling on this date. Coordinates are the same as that shown in Table 14.

Table 15: Results of in situ testing done April 13, 2024.

Sibun River at	**Monkey Bay S1**	**Tiger Sandy Bay Bridge S2**
Depth	Depth : Surface	Depth: 1 meter
Time	10:20 AM	1 PM
Temp C°	27.6	27.6
DO %	22.4	90.0
DO mg/l	6.14	6.9
SPC -us/cm	209.2	206.0
C -us/cm	219.6	222.3
TDS mg/l	135.85	135.85
SAL ppt	0.1	0.10
pH	7.85	7.18
Sampling conducted by E. Avella using YSI Professional Plus probe.		

In Situ Analysis - April 17, 2024.

Again, only two sites were sampled as the main purpose of the visit was for streamflow data. Data is shown in Table 16. Coordinates are the same as for Table 14.

Table 16 shows that the two sites tested on April 17 showed that most parameters displayed similar units on that day. These sites were tested since they were part of the streamflow being done on that day. At these sites, the average temperature was 28.9 degrees Celsius. The average dissolved oxygen in mg/l was 6.59, which are fairly acceptable levels for freshwater bodies. Specific conductivity averaged 206 mg/l.

Table 16: Results of in situ testing done 17 April 2024.

Parameter	Sibun River Watershed		Monkey Bay SI		Tiger Sandy Bay (Upstream from wooden bridge) S3	
	Date		17-Apr-24			
	Time		10:20 AM	12:15 PM	11:00 AM	11:30 AM
	Sample depth		0.3 m	0.4 m	0.4 m	0.4m
1	Temperature	C°	27.6	30.4	27.6	30
2	Pressure	mmHg	756.6	757.4	756.6	768
3	DO (SAT)	%/L	76	94	90	86.8
4	DO	mg/L ppm	6.14	6.73	6.9	6.59
5	SPC [cond]	µS/cm	209.2	204.5	206	206
6	C [cond]	mS/cm	219.6	225.6	222.3	7.8
7	C [cond]	Ω/cm	13403	14134.31	13406	13403
8	TDS	mg/l	135.85	132.6	135.85	4.56
9	Salinity	ppt	0.1	0.09	0.1	0
10	pH		7.85	7.57	7.18	9.14
11	pH	mV	—	-79.5	—	-170.3

In Situ Analysis - April 25, 2025

On April 25, 2024, in situ data was collected at six (6) sites, as shown in Table 17. These sites included two ponds that hold effluent water disposed from previous soft drink industry. On this date two sets of samples were taken at each of the first three (3) sites. The Sibun Bridge S4 and the ponds (S5 & S6) sites were tested once. Pond 1 was the pond with the higher concentration of effluent as can be seen from the results. The temperature was lower, at 26.6 ºC while Pond 2 was 34.3C. Both

ponds showed very low dissolved oxygen, indicating high bacteriological decomposition of organic waste. The DO in mg/l were 0.38 at Pond 1 and 0.49 at Pond 2. Similarly, the specific conductivity and conductivity were both much higher at Pond 1, with 3693 mg/l SPC and 3808 conductivities, while these were 187 and 220 mg/l respectively at Pond 2. TDS was also significantly higher (2,400 mg/l) at Pond 1 and only 121 mg/l at Pond 2.

Freshwater sites at the Sibun River were taken during the morning and afternoon. The average temperature was 29.77 ºC at these sites. The average dissolved oxygen in mg/l was 5.33. The average SPC was 213.6 mg/l while the conductivity was 256.7 mg/. TDS was 149 mg/l. Salinity at all sites was very low, averaging 0.11 ppt.

Table 17: Results of in situ testing done April 25, 2024.

Sibun River Watershed Near Tiger Sandy Bay (TSB) - IN situ water quality data - APRIL 25 2024Using YSI Professional Plus. Collected by: E. Avella & I. Fabro.										
Site No.	**Units**	**S1**		**S2**		**S3**		**S4**	**S5**	**S6**
Sibun River & 2 Treatment Ponds		**Monkey Bay**		**Bridge (2 TSB)**		**Sandy Bay**		**Sibun Bridge**	**Pond 1**	**Pond 2**
Date of Sampling	M/D/Y	4/25/2024	4/25/2024	4/25/2024	4/25/2024	4/25/2024	4/25/2024	4/25/2024	4/25/2024	4/25/2024
Time of sampling		8:42	4:00 PM	9:30	2:45	9:54	2:30	11:00	1:15 PM	1:35 PM
Depth		Surface	Surface	0.5 M	0.5	0.43		Surface	0.7 M	Surface
Temperature	Celsius (°C)	29.2	31	29.1	30.1	29.3	30.1	29.6	26.6	34.3
Barometric	(mm Hg)	760.9	757.9	759.9	758.3	759.9	758.3	759.9	757.4	758.6
Dissolved Oxygen (DO)	%	74.7	49	70.3	82.2	55	82.2	72	4.9	6.9
DO	mg/l	5.72	3.64	5.39	6.2	4.69	6.2	5.48	0.38	0.49
Specific Conductance (sp)	micro siemens/centi	236.6	217.4	237.8	221.9	238.3	221.9	247.6	3693	187.3
Conductivity ((us/cm)	micro siemens/cm	255.9	242.3	256.5	243.7	258	243.7	269.3	3808	220.6
Total Dissolved Solids (TDS)	Mg/l	154	141	155	144.3	155	135.2	161	2400	121.55
Salinity	Parts per thousand	0.11	0.1	0.11	0.1	0.11	0.1	0.12	1.94	0.09
pH	Units	6.67	7.68	6.66	8.18	6.79	8.12	6.94	7.09	8.25

In Situ Analysis – May 6, 2024

The sites sampled and tested on May 6, 2024, included two additional sites (S7 & S8). These were a pond with water from rainfall and possibly from the perched aquifer at an abandoned mining pit within the property as well as at a point farthest from the project site but near the easternmost boundary of the parcel located across the Coastal Plain Highway (Table 18).

These average reported levels for these sites were as follows:

Temperature – 30.65ºC,

Dissolved oxygen – 6.8 mg/l

Specific conductance – 192 mg/l

Conductivity – 212 mg/l

Total dissolved solids – 124 mg/l; and

Salinity - .085 ppt

In general, these sites showed low parameters, indicating fairly clean surface water bodies. The pond did show lower values for certain parameters, thus reflecting less contamination.

Table 18: Results of in situ testing done May 6, 2024.

Site No.	Units	S1	S2	S7	S8
Sibun River & 1 Mine pit Pond		Monkey Bay	TSB - Bay	Pond With tyres (abandoned mine)	Sibun River Downstream
Date of Sampling	M/D/Y	5/6/2024	5/6/2024	5/6/2024	5/6/2024
Time of sampling		9:45	10:17 AM	11:11	11:34
Depth		Surface	Surface	Surface	Surface
Temperature	Celsius (°C)	30.2	30.8	30.7	30.9
Barometric Pressure	(mm Hg)	757.1	757.1	756.5	756.9
Dissolved Oxygen (DO)	%	72.4	98	93.5	102.6
DO	mg/l	5.45	7.17	6.98	7.62
Specific Conductance (sp)	microsiemens /centimeter - ms/cm	226.7	225.6	74.7	241
Conductivity ((us/cm)	microsiemens /cm	249.2	250.4	82.8	268.1
Total Dissolved Solids (TDS)	Mg/l	147.55	146.9	48.75	156.65
Salinity	Parts per thousand (ppt)	0.11	0.1	0.03	0.1
pH	Units	6.29	7.68	6.21	6.28

Data Collected by I.E. Fabro and E. Avella using YSI Professional Plus instrument.

In Situ Analysis July 15,2023.

Earlier on July 15, 2023, in-situ water quality measurements were also conducted using the YSI Professional Plus Water probe at several sites along the Sibun River (Table 19). The results are presented in Table 20 as historical reference of water quality in the Sibun River. The results were generally consistent and within the acceptable range for key parameters for water in the natural environment.

Table 19: In situ Water Quality sampling sites at locations on the Sibun River.

Sampling Site	Tributary/Location	Eastings	Northings	Date Sampled	Remarks
#1	Sibun River at La Democracia Bridge, Coastal Plain Road	0338486	1917693	7/15/23	YSI probe
#2	Sibun River at Monkey Bay	0334801	1913422	7/15/23	YSI probe
#3	Sibun River at Mile 34	0332968	1910876	7/15/23	YSI probe
#4	Sibun River at Monkey Bay	0334801	1913422	7/06/23	Laboratory sample

Table 20: In Situ Water Quality analysis results for sampling sites on the Sibun River, July 15, 2023.

			Sample Site-1			Sample Site-2			Sample Site-3		
	Parameters		Sibun River, La Democracia Bridge on the Coastal Road			Sibun River at Monkey Bay Mile 32 GPH			Sibun River Mile 34, near Roca Fuerte Cement Factory		
SS	Time Sampled	Units	11:16 am	11:18 am	11:20 am	11:52 am	11:54 am	11:56 am	12:40 pm	12:42 pm	12:44 pm
1	Temperature	°C	30.8	30.0	29.9	30.2	29.8	29.7	30.9	30.6	30.5
2	Pressure	mmHg	760.86	760.86	760.86	760.86	760.86	760.86	760.86	760.86	760.86
3	DO (SAT)	%/L	97.61	87.38	86.39	99.14	102.46	102.74	106.66	108.86	108.77
4	DO	mg/L	7.28	6.61	6.55	7.48	7.77	7.81	7.94	8.15	8.16
5	DO	ppm	7.28	6.61	6.55	7.48	7.77	7.81	7.94	8.15	8.16
6	SPC	mS/cm	254.00	252.28	252.39	219.34	247.91	248.59	244.53	245.93	246.26
7	C	µS/cm	280.26	276.17	275.67	239.94	270.56	270.99	271.71	272.02	271.90
8	TDS	ppm	165.10	163.98	164.05	142.57	161.14	161.59	158.94	159.85	160.07
9	Salinity	psu	0.1214	0.1205	0.1206	0.1045	0.1184	0.1188	0.1167	0.1174	0.1176
10	pH	pH units	8.00	7.65	7.64	7.93	7.85	7.83	7.97	7.96	7.97
11	ORP	mV	169.48	178.94	180.80	182.57	189.25	191.70	217.04	217.24	216.67
12	Turbidity	NTU	5.40	4.06	3.91	5.08	2.47	2.92	2.78	2.60	2.50
	Location		17.3390	-88.5200		17.30001	-88.5544		17.2767	-88.5715	

Abbreviation/Considerations:

ND= Not detected; NT= Not tested; LOD= Detection limit; LOQ= Quantification Limit

CFU= Colony Forming Units; TNTC=Too Numerous to Count; CG= Confluent Growth

* Take with caution this result, because it was analysed after the regulatory holding time

** = Results obtained via dilution. DO Dissolved Oxygen; SPC Specific Conductivity.

C Conductivity; TDS Total Dissolved Solids; OPR Oxidizing and Reducing Potential (mV).

NI= Not Indicated; NA= Not applicable. PSU salinity unit comparable with ppt.

2.8.2 Groundwater: Bacteriological & Chemical Analysis for La Democracia and Mahogany Heights

Laboratory water samples were also extracted from untreated tap well water at La Democracia Village and Mahogany Heights on Wednesday, July 5, 2023, See Table 21 for Bacteriological analysis results and Table 22 for the Chemical results as analysed by the Public Health Water Laboratory.

Table 21: Bacteriological water quality analysis results for untreated water sample for Mahogany Heights and La Democracia.

National Drinking Water Quality Laboratory
Ministry of Health
Bacteriological Sampling Form

Sample Information									Laboratory Resu		
Samplers Name:	Uriel Sosa								Microorganisms Te		
District: Belize		Sanitary District #:									
Date Collected:	5-Jul-23			Date Received:							
Condition Sample Received:				Cold	Warm						
Date Incubated:		Time Incubated:									
Date Read:		Time Incubation Stopped:									
Bottle #	Area	Time	Sample Type	Sample Description	Source	System	Water Type	Free Chlorine	Total Coliform x/100 ml	Fecal Coliform x/100 ml	E. Coli x/100 ml
	City	am	Routine		Ground (G)	BWS, RWS	Treated (T)	mg/ L			
	Town	pm	Repeat		Surface (S)	BW, HP, RWT	Untreated (T)				
	Village		Special		Tank (T)	PWS, ICE,PW					
MH 1	M. Heights	9:50	Routine	Police Station- tap	Ground (G)	RWS	Untreated (T)	0		10	
MH 2	M. Heights	10:00	Routine	Anya's Grocery Shop-tap	Ground (G)	RWS	Untreated (T)	0		8	
MH 3	M. Heights	10:10	Routine	Super Market- tap	Ground (G)	RWS	Untreated (T)	0		5	
D 1	Democracia	10:18	Routine	Kira's Cool Spot-tap	Ground (G)	RWS	Untreated (T)	0		14	
D 3	Democracia	10:30	Routine	K & S Grocery Shop-tap	Ground (G)	RWS	Untreated (T)	0		17	
D 2	Democracia	10:24	Routine	Gov't school- tap	Ground (G)	RWS	Untreated (T)	0		13	

Signature of Sampler: Signature of Analyst: A.Sosa

Laboratory Remarks: The WHO Guidelines for Total Coliform , Fecal Coliform, E. Coli & P. Aeruginosa in drinking water is 0/100 ml.
Both RWs sytems are contaminated and a consistent chlorination is needed in both of these communities. Please resample when this process is carried out.

As can be observed in Table 21, both the Mahogany Heights and La Democracia Villages RWS untreated samples are contaminated. Faecal Coliform Colony Formation Units (CFU/100 ml) were all above the WHO limits (0 CFU/100 ml) for human consumption. The results for the samples taken range from 17 to

14 CFU/100 ml for La Democracia samples to 10-5 CFU/100 ml for Mahogany Heights. It must be noted that all samples were from untreated groundwater.

A summary of the Laboratory Chemical analysis results is presented in Table 22. The result shows that parameter concentrations were higher for the La Democracia samples compared with those for Mahogany Heights, however, all results were within or below the WHO limits (Table 23) for natural groundwater. Total Dissolved Solids, Conductivity, Sulphate and Salinity were much higher in the La Democracia samples.

Table 22: Chemical water quality analysis results for untreated water sample for La Democracia and Mahogany Heights.

Ministry of Health Water Laboratory							
Chemical Sample							
District	Cayo		**City**		**Town**	La Democracia & Mahogany H.	**Village**
Date Sample Collected	5-Jul-23				**Time**	9:51 AM	
Sampling Site	GOB School Handwash Tap		Police Station yard tap				
Type of water source		√	Groundwater		Surface		Rainwater
Type of system			BWS	√	RWS		BW
Type of water			Treated	√	Untreated		
Type of sample		√	Routine		Special		Repeat
Bottle #		BC #15					
Date Sample received	5-Jul-23		**Date sample analyzed**	6-Jul-23			
Parameter	**Units**	**WHO Limits**	**La Democracia**		**Mahogany H**	**Possible Effects**	
Alkalinity	mg/L		212.00		135.00		
Sulfate	mg/L	500.00	450.00		15.00	Taste, corrosion	
pH		6.5-8.5	7.47		7.67	Taste, appearance, corrosion	
Turbidity	NTU	5.00	0.829		0.782	Appearance	
Chlorides	mg/L	250.00	20.00		8.00	Salty taste, corrocion	
Hardness	mg/L		652.00		141.00		
Conductivity	umhos.cm		1181.00		375.40		
Nitrate-N	mg/L	10.00	1.10		1.00	Methaemoglobaemia	
Nitrate	mg/L	50.00	4.80		4.50	Methaemoglobaemia	
Phosphate	mg/L		0.34		0.20		
Phosphorous	mg/L		0.11		0.06		
Manganese	mg/L		0.60		0.50		
Salinity	psu/ppt	0.70	0.637		0.232	Salty taste, corrosion	
Iron	mg/L	0.30	0.05		0.04	Bitter taste, red color	
Total Dissolved Solids	mg/L	1000.00	579.40		184.70	Taste	
Free Chlorine			N/D		N/D		
Laboratory Remarks:	N/D	Not detected					

Table 23: Acceptable Limits for BWSL, WHO and DOE Guidelines.

Parameter	Acceptable Limits (BWSL)	Guideline Values (WHO) / DOE	Remarks on water quality parameters
Temperature	25 °C	None / ≤ 33 °C	
pH	6.5 – 7.5	6.5 – 8.5 / 6 - 9	Value of 7 indicates neutral condition
Colour		15 TCU	Less than 10 units is unnoticed, water with 100 units resemble black tea
Turbidity	5 units	5 NTU	Pure distilled water turbidity is 0 NTU
TDS	500 mg/L	1,000 mg/L	TDS of 0-1000 is considered fresh and non-saline
Conductivity	N/A	none	Range 50–1000 µS/cm found in natural fresh water
Hardness (total)		none	Water with hardness less than 120 mg/L is deemed desirable, in excess of 500 mg/L undesirable for domestic and industrial use
Alkalinity	250 mg/L	N/A	Generally acceptable water range for alkalinity is 30 – 500 mg/L
Biological Oxygen Demand (BOD)		/ 50 mg/L	DOE effluent standards
Chemical Oxygen Demand (COD)		100 mg/L	DOE effluent standards
Chlorine (free)	N/A	5 mg/L	
Coliform (total)	1/100 ml	0/100 ml	
E-coli	1/100 ml	0/100 ml	
Nitrate - N	10 mg/L	10 mg/L	
Chloride	250 mg/L	250 mg/L	250 mg/L is the acceptable value for drinking water
Fluoride	0.5 – 1.5 mg/L	1.5 mg/L	
Phosphate	N/A	None / 5	
Sulphate (SO_4)	250 mg/L	250 mg/L	Concentrations up to 500 mg/L acceptable
Magnesium (Mg^+)	N/A	none	
Aluminium (Al^{3+})	N/A	0.2 mg/L	
Calcium(Ca^{2+})	N/A	none	
Iron (Fe)	0.3 mg/L	0.3 mg/L	

Lead (Pb)	N/A	0.01 mg/L	

(Source: Environmental Water Quality Monitoring Program (NARMAP) Final Report, June 1995, DOE/USAID; DOE Effluent limitation, Amended Regulations 2020).

Laboratory analysis done on April 17, 2024

These samples taken on the 17th of April 2024 were analysed and is presented in Table 24 and Appendix IV. The sites are those listed in Table 14.

Thew results show that nitrate levels ranged from 0.7 to 1.7 mg/l, which are fairly low. Phosphate levels were also low. Total coliform levels were a bit elevated at all sites, including at Monkey Bay River site, and the Tiger Sandy Bay sites.

Table 24: Bowen and Bowen Analysis Results.

BOWEN & BOWEN LIMITED					
WATER & WASTE LABORATORY					
ENVIRONMENTAL & DRINKING WATER ANALYSIS SERVICES					
Sample Taken: April 17th 2024					
PARAMETER	**S-01**	**S-02**	**S-03**	**S-04**	**S-05**
	1	2	3	4	5
INORGANIC COMPOUNDS					
Nitrate	1.4	1.6	1.7	0.6	0.7
Phosphate	0.02	0.03	0.04	0.01	0.02
Sulphate (SO4)	0	0	1	0	1
ORGANIC COMPOUNDS					
OXYGEN DEMAND, BIOCHEMICAL (BOD)	NT	NT	NT	NT	NT
MICROBIOLOGICAL ANALYSIS					
Total Coliform (Surface, Ground and Environmental)	21	19	27	14	16
Faecal Coliform (Potable)	< 1	< 1	< 1	< 1	< 1

Laboratory analysis done for Samples taken May 6, 2024

With respect to the data presented, Site S03 in Appendix V corresponds to Site S7 in Table 25 and Site S 04 corresponds to Site S8 in the same table. The location and details of site S7 and S8 are shown in Table 14 and Table 20.

The laboratory results of the samples taken indicate that nitrates and sulphates are as low as those taken in April 17th, 2024. However, COD readings were taken in this set of samples and these ranged from 8 to 26 mg/l.

Total coliform count was much higher than those for the April samples. These ranged from 82 CFU/ 100 ml at the downstream sample to 201 CFU/ 100 ml. at the Tiger Sandy Bay Sibun site (Table 25).

Site S03 in Appendix V corresponds to site S7 in Table 25 and Site S04 corresponds to site S8 in the same table. The location and details of site S7 and S8 are shown in Table 14 and Table 20.

The laboratory results of the samples taken indicate that nitrates and sulphates are as low as those taken in April 17th, 2024. However, COD readings were taken in this set of samples and these ranged from 8 to 26 mg/l.

Total coliform count was much higher than those for the April samples. These ranged from 82 CFU/ 100 ml at the downstream sample to 201 CFU/ 100 ml at the Tiger Sandy Bay Sibun site (Table 25).

Table 25: Laboratory Results of Sampling done May 6, 2024.

Site No.	Units	**S1**	**S3**	**S7**	**S8**
Sibun River & 2 Ponds		Monkey Bay	TSB - Bay River	Pond (With tires)	Sibun River Downstream
INORGANIC COMPOUNDS	Unit				
Nitrate	Mg/l	0.03	0.42	0.68	0.03
Phosphate	Mg/l	0.06	0.02	0.03	0.02
Sulphate	Mg/l	1	2	2	1
ORGANIC COMPOUNDS					
Chemical Oxygen Demand (COD)	Mg/l	13	8	20	26
MICROBIOLOGICAL ANALYSIS					
Total coliform	cfu/100 ml	153	201	189	82
Faecal coliform	cfu/100 ml	30	30	17	<1

2.8.3 Water Quality Standards and Water Sample Tests Results from in-situ measurements and laboratory analysis

Bacteriological Quality: The coliform bacteria group consists of several genera of bacteria belonging to the family Enterobacteriaceae. These mostly harmless bacteria live in soil, water, and the digestive system of animals. Faecal coliform bacteria, which belong to this group, are present in large numbers in the faeces and intestinal tracts of humans and other warm-blooded animals and can enter water bodies from human and animal waste. While faecal coliform is not pathogenic (disease - causing), they are commonly found alongside pathogenic organisms such as those responsible for dysentery, gastroenteritis, and hepatitis A. It is easier to test for faecal coliform than for pathogenic organisms; therefore, the presence of faecal coliform in a water sample is used to indicate potential contamination. If a large number of faecal coliform bacteria (over 200 colonies/100 millilitres (ml) of water sample) are found in water, it is possible that pathogenic (disease- or illness-causing) organisms are also present in the water.

Faecal Coliform and Escherichia Coli (E coli /100 ml)

The micro-biological test results showed evidence of water contamination in the untreated groundwater samples taken from the taps at Mahogany Heights and La Democracia (Table 21). In Table 24, the range of Total Coliform ranged from 14 to 27 CFU/100 ml. Faecal Coliform (Potable) was greater than 1 in all samples.

Temperature (°C)

High water temperature indicates thermal pollution and influences most physical, chemical, and biological processes. Many water quality parameters vary with temperature, for example Dissolved Oxygen (DO). The water temperature in Sibun River on July 15, 2023, ranged from 29.7 °C to 30.1 °C. See Table 20. Ambient water temperature for water bodies in Belize is generally higher during the dry season and summer months, so the values recorded are acceptable.

Pressure (mmHg)

The YSI Professional Plus Water probe measures 'true' (uncorrected) values of air pressure in mmHg. True BP = [corrected BP] – [2.5 * (local altitude in feet above sea level/100)]. Weather service readings are usually not "true", i.e., they are corrected to sea level, and therefore cannot be used until they are "uncorrected". At mean sea level the average pressure is 1013.5 Pa or 760 mmHg. The in situ YSI water column pressure for the 8 samples taken during the three sampling days was 760.86 mmHg. See Table 20 above.

Hydrogen Ion Concentration, pH (Standard Units)

pH in water is related to soil makeup and inorganic content. Depending upon the relative hydrogen ion concentration, water can be either basic or acidic. The pH of surface waters is important to aquatic life because pH affects the ability of fish and other aquatic organisms to regulate basic life-sustaining processes, primarily the exchanges of respiratory gases and salts with the water in which they live. Failure to adequately regulate these processes can result in numerous sub-lethal effects (e.g., diminished growth rates) and even mortality in cases when ambient pH exceeds the range physiologically tolerated by aquatic organisms. The pH of water affects the normal physiological functions of aquatic organisms, including the exchange of ions with the water and respiration. The normal pH range that is considered satisfactory for fish and other freshwater aquatic organisms is 6.0 - 9.0. The in situ YSI water pH for the Sibun River measured on July 15, 2023, ranged from 7.64 to 8.00. See Table 20.

Turbidity (Nephelometric Turbidity Units or NTU) is a measure of the suspended particles such as silt, clay, organic matter, plankton and microscopic organisms, which are usually held in suspension by turbulent Brownian flow. It is impractical to assign a range of values to turbidity; however, non-detectable turbidity may be approximated by pure distilled water or "0" (zero) NTU. The number of solid materials in suspension may result from natural erosion, runoff, and algal blooms, although some of this material may be the result of anthropogenic activities. The concentration and particle size may cause significant variation of turbidity values. Turbidity is normally high during the rainy season runoff. High turbidity reduces the photosynthesis of submerged, rooted aquatic vegetation and algae; this reduced plant growth may in turn suppress fish productivity. Turbidity, therefore, can affect aquatic biological communities. Water quality guidelines suggest that discharges resulting from human activities should not alter ambient

turbidity levels. Turbidity levels at the three sites in the Sibun River ranged from 2.47 to 5.40 on July 15, 2023. See Table 20 above.

Total Dissolved Solids (TDS, mg/L)

TDS is an index of the quantity of dissolved substances in water. The presence of such solutes alters the physical and chemical properties of water. For the purpose of the survey, the range of TDS from 0 – 1000 mg/L is considered fresh and non-saline. The base flow of a waterway acquires mineral constituents in the form of dissolved salts in solution, such as sodium, chloride, magnesium, sulphate, etc. In periods of high runoff, overland flow contributes dissolved materials to water sources. In addition, significant contributions to the TDS are anthropogenic in the form of municipal and industrial effluents, and agriculture runoff.

Established guidelines on the concentration of TDS relate to taste and palatability rather than detrimental health effects on man or aquatic organisms. TDS concentrations of 500 mg/L or less have been designated as an objective level for drinking water. TDS in situ measurement for the three sites on the Sibun River measured on July 15, 2023, ranged from 142.57mm/L to 165.1 mm/L (See Table 20). The laboratory analysis for TDS for the Monkey Bay sample was 8.0 mg/L.

Total Hardness (mg/L)

The laboratory analysis for Total Hardness in the Sibun River for the Monkey Bay sample was 140 mg/L. See results in Table 20.

Conductivity (or Specific conductance, µS/cm) is a numerical expression of the ability to conduct an electrical current in water. It is measured in micro-Siemens per centimetre (µS/cm) corrected to a standard temperature, usually 25 °C. The conductivity of water is dependent on its ionic concentration and temperature. Conductivity provides a good indication of the changes in water's composition, especially in its mineral concentration. It is particularly sensitive to variations in dissolved solids but provides no indication of the relative quantities of the various components. As more dissolved solids are added, the water's specific conductance increases. Specific conductance in natural waters has been found to range from 50 to 1500 µS/cm. Groundwater usually have elevated specific conductance. The specific conductance in surface water is usually highest when groundwater infiltration provides significant portion of the stream flow and is lowest in the wet season due to dilution. No guidelines have been established to regulate specific conductance since high values are found to correlate with total dissolved solids.

The YSI in situ measurement for specific conductivity in the Sibun River at the three sites visited on July 15, 2023, ranged from 219.34 to 254.0 μS/cm. See Table 20 above.

Salinity (ppt)

Salinity is defined as the total concentration of dissolved ions in water. Salinity often is expressed in milligrams per litre (mg/L), but in aquaculture, it is more convenient to express salinity in parts per thousand (ppt). One can divide salinity values expressed in mg/L by 1000 to get parts per thousand; e.g., 5,500 mg/l = 5.5 ppt.

Salinity of freshwater often is considered to be 0 ppt, but most inland waters contain from 0.05 to 1 ppt salinity. In situ salinity measurement for the three sites on the Sibun River on July 15, 2023, ranged from 0.10 to 0.12 ppt (Table 20).

Dissolved Oxygen (DO, Dissolved Form or Per cent Saturation; mg/L or %)

The stream system both produces and consumes oxygen. It gains oxygen from the atmosphere and from plants as a result of photosynthesis. Running water, because of its churning, dissolves more oxygen than still water, such as in a reservoir behind a dam. Respiration by aquatic animals, decomposition, and various chemical reactions consume oxygen.

Oxygen is measured in its dissolved form as dissolved oxygen (DO). If more oxygen is consumed than is produced, dissolved oxygen levels decline and some sensitive animals may move away, weaken, or die.

In situ measurements of DO revealed values ranging from 6.55 mg/l to 8.15 mg/L. DO less than 5 mg/L is unfavourable for aquatic organisms. See Table 20 above.

Oxidizing and Reducing Potential (ORP, mV)

Oxidizing and Reducing Potential (ORP) of water sample is a measure of the presence of oxygen in the water column. Excess chlorine in wastewater effluent will result in a large positive ORP value and the presence of hydrogen sulphide will result in large negative value of ORP. Values for in situ ORP measurements in the Sibun River ranged from +169.48 mV to +217.24 mV for the three sites monitored on July 15, 2023. The values of ORP are acceptable for natural surface water. See Table 20.

Orthophosphate (Phosphate, mg/L)

If too much phosphate is present in the water algae and weeds will grow rapidly, may choke the waterway, and use up large amounts of precious oxygen (in the absence of photosynthesis and as the algae and plants die and are consumed by aerobic bacteria.) The result may be the death of many fish and aquatic organisms. Phosphorus is one of the key elements necessary for growth of plants and animals. Phosphates (PO_4) are formed from this element. Phosphates exist in three forms: orthophosphate, metaphosphate (or polyphosphate) and organically bound phosphate.

Criteria: The following criteria for total phosphorus were recommended by US EPA (1986):

1) no more than 0.1 mg/L for streams which do not empty into reservoirs,
2) no more than 0.05 mg/L for streams discharging into reservoirs, and
3) no more than 0.025 mg/L for reservoirs.

Laboratory analysis for Phosphates for the area were well within the above criteria ranging from 0.01 to 0.06 mg/L (Tables 24 and 25).

Nitrate (N, mg/L)

Outside of agricultural practices, nitrates can also come from septic systems and, to a much lesser extent, naturally decaying organic matter (CAST 1992). Nitrate is highly soluble and can thus migrate easily through the soil. Nitrates are naturally formed in the environment by nitrogen-fixing bacteria, as well as in high temperatures such as those found in lightning (Bunce 1993). Nitrogen, like phosphorous, is a required plant nutrient and so is added to soil to improve crop yields. Nitrates are a form of nitrogen, which is found in several different forms in terrestrial and aquatic ecosystems. These forms of nitrogen include ammonia (NH3), nitrates (NO3), and nitrites (NO2). Nitrates are essential plant nutrients, but in excess amounts, they can cause significant water quality problems. Together with phosphorus, nitrates in excess amounts can accelerate eutrophication, causing dramatic increases in aquatic plant growth and changes in the types of plants and animals that live in the stream. This, in turn, affects dissolved oxygen, temperature and other indicators. The natural level of ammonia or nitrate in surface water is typically low (less than 1 mg/L). Nitrate concentration as analysed for the area for April 17, 2024, were higher than 1 mg/L for Samples S01, S02 and S03 at 1.4 mg/L, 1.6 mg/L and 1.7 mg/l, respectively (Table 24) and Sample S04 and S05 were below. Samples taken in May 6, 2024 (Table 25) were all below the 1 mg/L threshold ranging from 0.03 to 0.68 mg/L (Table 25). This can be attributed to Nitrate

levels decreasing within a month due to several factors, including plant uptake, denitrification, and changes in water flow (rainfall or flooding in the area).

Sulphate ($SO2^{2-}$, mg/L)

Sulphate is the concentration of the oxidized form of aqueous sulphur in water. Sources include acid mine drainage (oxidation of sulphide minerals) and acid precipitation. The sulphate ion is reported to cause cathartic action in humans at a concentration above 250 mL (DOE, 1995). High sulphate concentration also contributes to poor water taste in the presence of sodium and magnesium.

Sulphur is a non-metallic element that occurs naturally in numerous minerals, including barite ($BaSO4$), epsomite ($MgSO4.7H_2O$), and gypsum ($CaSO4.2H_2O$). Hexavalent sulphur combines with oxygen to form the divalent sulphate ion ($SO4^{2-}$). The reversible reaction between sulphide and sulphate in the natural environment is often referred to as the "sulphur cycle".

Natural sources of sulphur include volcanoes, decomposition and combustion of organic matter and from sea salt over the oceans. Particles of sea salt formed by the breaking of myriads of bubbles are an important source of atmospheric sulphate.

The atmosphere is the main vehicle for transport of sulphur from various sources. Sulphates are discharged into the aquatic environment in wastes from industries that use sulphates and sulfuric acid, such as mining and smelting operations, kraft pulp and paper mills, textile mills and tanneries. Table 26 shows the Water Quality Guidelines for Sulphate.

Table 26: Water Quality Guidelines for Sulphate.

Water Use	Dissolved Sulphate as mg/L (ppm) SO_4
Drinking water (Aesthetics)	500
Fresh aquatic life	At 50 Alert level to monitor health of aquatic moss population on an occasional basis.
	At 100 Maximum concentration, not to be exceeded at any time.

The results in Table 24 and Table 25 are 0 to 1 mg/L and 1 to 2 mg/L respectively. When compared to Tables 26 parameters, these results are far below the Alert Limit and Maximum Limit.

CHAPTER 3 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

3.1 National Policy

This chapter outlines the policy, legal, and administrative framework relevant to the proposed development as required under the approved Terms of Reference (Appendix I). Belize's national environmental and agriculture policies are rooted in an integrated environmental management approach towards sustainable development, which the national government has adopted and supported through various sectoral policies, guidelines, and current legislative frameworks. It has a set of comprehensive laws and regulations that address environmental protection, sustainable agriculture and forestry practices, natural resource development, wildlife conservation, preservation of historical and cultural resources, pollution control, solid waste management, and other sustainable development initiatives. In response to the global phenomenon of climate change and its local impacts, Belize is also adopting and promoting robust climate-resilient planning at all levels, including climate-smart and energy-efficient technologies. Additionally, Belize is a signatory to various international agreements aimed at protecting the environment and natural resources.

3.2 Natural Resources Management Policy

Belize’s economy is highly dependent on its natural resource base, particularly in the agriculture, fisheries, and tourism sectors which contribute to the bulk of our gross domestic product. The natural endowment of Belize indicates a fairly abundant natural resource, both terrestrial and marine based. This offers Belize a competitive advantage over other countries and offers a wealth of natural resources to support economic growth in the agriculture, fisheries, forestry, and tourism sectors. At the same time, the Government of Belize (GOB) is committed to the conservation of biological diversity, sustainable use of biological resources, and the fair and equitable sharing of benefits derived from the use of genetic resources. The policy measures taken by the government are to ensure that the benefit of economic growth is felt as improved livelihoods and well-being for most of the citizens, especially those living in poverty, while at the same time protecting its natural resource base.

As a result of its commitment to this policy, the Government of Belize has established laws, regulations, guidelines, and standards that govern the use and enjoyment of its natural resources, and biodiversity. These laws and regulations are implemented by various Government Departments. Laws and regulations guide development by specific guidelines, regulations, and legislation guiding sustainable development and controlling pollution, infrastructure planning, and climate resilience in investment; thus, making sure that adequate technology is employed for the control of emissions and pollutants or any adverse effect on the environment.

Non-governmental organizations (NGOs), community-based organizations (CBOs), and local communities also participate in the process of natural resource stewardship through various mechanisms. Belize has formal and informal agreements with the NGO Community for assistance in the management of its natural resources. Some Government bodies with direct responsibility for the protection of biodiversity and Belize's natural resources include the Agriculture Department, Fisheries Department, the Forest Department, the Department of Environment, and the Coastal Zone Management Authority and Institute. NGOs are very active in the conservation effort, and several umbrella organizations now have active participation in management efforts and lobbying efforts. Statutory bodies include the Belize Agriculture Health Authority (BAHA), the Pesticides Control Board (PCB), The Solid Waste Management Authority (SWaMA), among others.

3.3 Administrative Framework

3.3.1 Introduction

The Government institutions that are considered most relevant to the SLCCL agriculture project which are responsible for environmental protection and natural resources management, and sustainable agriculture management are listed in Table 27. These institutions include the following:

1. The Ministry of Sustainable Development, Climate Change and Solid Waste Management, which includes the Department of the Environment (DOE), Forest Department, and National Climate Change Office.
2. Ministry of Natural Resources, Petroleum, and Mining.

3. Ministry of Agriculture, Food Security, & Enterprise. This includes statutory bodies such as the Belize Agriculture Health Authority (BAHA) and the Pesticides Control Board (PCB).
4. Ministry of Health and Wellness.
5. Ministry of Rural Transformation, Community Development, Labour and Local Government.

Table 27: Key Institutional framework relevant to SLCCL.

Ministry	Key Department/Statutory Bodies	Key Roles
Ministry of Sustainable Development, Climate Change and Solid Waste Management	Department of the Environment – DOE	Environmental protection/ manages EIA process/Pollution control.
	Forest Department	Declares and manages forest reserves/Licensing for timber and forest product use.
	National Climate Change Center	Its goal is to facilitate the coordination of Belize's national and international response to climate change, (Source: https://sustainabledevelopment.gov.bz/national-climate-change-office/).
Ministry of Natural Resources, Petroleum, and Mining.	Lands Department	Land and Land Management, Land Surveys, Mining, Physical Planning (subdivisions).
	Mining Unit	Regulates mining resources. Permitting agency for mining of construction material.
	Solid Waste Management Authority (SWaMA)	Responsible for solid waste management and permitting waste disposal sites.
Ministry of Agriculture, Food Security, & Enterprise	Agriculture Department	According to the Department's web site, the Department's aim is to provide an environment that is conducive to increase production and productivity, promoting investment, and encouraging private sector involvement in agribusiness enterprises in a manner that ensures competitiveness, quality production, trade and sustainability (Source: https://www.agriculture.gov.bz/).

	Belize Agriculture Health Authority (BAHA)	Has authority over the lighting of fires for agriculture processes through the application of a license to do so. Among its responsibilities, this agency seeks to provide animal health, plant health, and food safety services. Its mission is to serve Belize by providing efficient, competent and cost-effective professional animal health, plant health, quarantine and food safety services that protect human health, animal health and welfare, plant health and the environment, ensure safe and wholesome food, strengthen national food security and facilitate trade and commerce. (Source: https://baha.org.bz/about-us/mission-and-vision-statements/).
	Pesticides Control Board (PCB)	The PCB is aimed at ensuring the comprehensive control of pesticides in Belize (Source: PCB Web site: www.pcbbelize.com). It does this through the regulation of importation of pesticides and has a comprehensive register of pesticides. An application process via a licensing system is in place for importation, manufacturing, distribution and application of registered and restricted pesticides.
Ministry of Health and Wellness	Public Health Department	This agency administers overall health and public safety in all areas. The main areas of services include Food Safety, Sea and Airport Health, Drinking Water Testing and plant approvals, Environmental Sanitation, Communicable Disease Investigation, Rabies Control, Complaints Investigation and prosecution of offenders. (Source: Ministry of Health web site: https://www.health.gov.bz/services/public-health/).
Ministry of Rural Transformation, Community Development, Labour & Local Government	Department of Labour	The Department of Labour has broad regulations and oversees employment and labour conditions, compensations, etc. It is responsible for delivering labour administration services to all stakeholders through the development and implementation of national labour laws and policies, consistent with international standards, in order to promote industrial harmony

		(Department of labour web site: https://www.ruraltransformation.gov.bz/the-ministry/labour/. Occupational Safety and Health Bill. This Bill is in its draft format and the cabinet of Belize recently approved amendments. This bill will address workers safety and health related issues at the workplace.

Other Important Institutions are as follows:

a) Ministry of Infrastructure Development & Housing.
b) Ministry of The Blue Economy, and Marine Conservation.
c) Ministry of Public Utilities, Energy, Logistics.
d) Ministry of Home Affairs & New Growth Industries.
e) Ministry of Public Service and Governance and NEMO (Disaster Management)

3.3.2 The Ministry of Sustainable Development, Climate Change and Solid Waste Management

The ministry is responsible for the following sectors and departments: Climate Change, Environment, Forestry, Protected Areas and Reserves, Solid Waste Management (SWaMa) and the Protected Areas Conservation Trust (PACT).

The Department of Environment is established through the enactment of the Environmental Protection Act, Chapter 328 Revised Edition 2020 of the Substantive Laws of Belize. This institution is entrusted with a wide range of responsibilities including the guidance and regulations of development activities by the commercial, industrial, and the private sector. This Department also pursues the encouragement of the adoption of environmentally friendly technology, the control of pollution, the scoping of development projects, the administration of the EIA process, and the sustainable use of natural resources and the environment. It is also responsible for environmental monitoring of commercial and industrial activities.

The Forest Department is entrusted with the managerial responsibilities towards Belize's forest resources. The Forest Department is responsible for the implementation of the Forest Act, Revised

Edition 2020, the National Protected Areas Systems Act Revised Edition 2020, the Wildlife Protection Act, Revised Edition 2020 and the Forest Fires Protection Act Revised Edition 2020. The Forest Act authorizes the Minister to declare forest reserves and to de-reserve forest reserves. The act also authorizes Forest Officers from the Forest Department with wide functions to regulate the forest industry. A licensing system for the exploitation of forest produce is in place, with regulatory framework guiding the application process, including fee structures for forest produce.

3.3.3 Ministry of Agriculture, Food Security and Enterprise.

The Ministry of Agriculture, Food Security, and Enterprise is responsible for agriculture, Agro-industry, Aquaculture, Animals and Birds, Belize Agricultural Health Authority (BAHA), Belize Marketing and Development Corporation Markets (Domestic), Banana Industry, Citrus Industry, Sugar Industry, Cooperatives, and Veterinary and Animal Health. This ministry is also responsible for the Aquaculture Industry.

The Department of Agriculture. According to the Department of Agriculture's web site, this Department's primary role is "to develop and transfer environmentally friendly technologies that will make farming more sustainable and farmers more competitive. This is being accomplished with the collaboration of other partners in development like the Caribbean Agricultural Development Institute (CARDI), Inter-American Institute for Cooperation on Agriculture (IICA), Republic of China (Taiwan) ROC, Belize Agriculture Health Authority (BAHA), Belize Marketing and Development Corporation (BMDC), Farmers Association (CREI), among others." Source: https://www.agriculture.gov.bz/

The Agriculture Department has agriculture offices in each district, and one experimental station at Central Farm. According to the Department's web site (https://www.agriculture.gov.bz/district-offices/), the extension services were initiated in the 1920s. The main goal of the department is to "train and build capacity among agricultural producers.". The Agriculture Department lists its duties and responsibilities as follows:

1. Advise farmers on the techniques and technology used in agricultural production. This includes inter alia; introducing new varieties of crops and efficient crop husbandry, proper

use of fertilizers and other agrochemicals, post-harvest/handling of crops, livestock husbandry, and related farming activities.

2. Promote a commodity or commodities to farmers.
3. Organize and conduct training for farmers through farm visits, seminars, workshops, demonstrations, field trips, and meetings using a participatory approach.
4. Work with marketing, credit, research, and regulatory institutions to incorporate them in the agriculture production system.
5. Collect and provide statistical data pertaining to crops, livestock, and agro-processing.
6. Assist with the promotion of school gardening and related agriculture education programs. (Source: https://www.agriculture.gov.bz/).

The Agriculture Department has the following units: Policy and Private Sector Interface Unit, The National Food and Nutrition Security Commission, Water Management and Climate Change Unit, Projects Execution Unit, District Agriculture Department Office, and the Central Farm Agriculture Station.

There are also several Statutory Bodies that form part of the ministry. These Include BAHA which is a statutory body designated to modernize the Agriculture Health Services in Belize (BAHA, 2012). Another important statutory body is the Pesticides Control Board (PCB). The PCB is responsible for the implementation of the provisions of the Pesticides Control Act, Chapter 181 B Revised Edition 2020 of the Substantive Laws of Belize. The PCB regulates the importation and use of pesticides in Belize (discussed further below). The BMDC, is another statutory board whose responsibility is to support the ministry as it seeks to ensure food security, enhancing product development and providing marketing services for small agro-businesses.

The Belize Agriculture Health Authority (BAHA) is a statutory body designated to modernize the Agriculture Health Services in Belize (BAHA, 2012). It was established under the Belize Agriculture Health Authority Act, Chapter 211 Revised Edition 2020 of the Substantive Laws of Belize. BAHA is governed by a Board of Directors, which is the policy making body of the Authority, with representatives from both Government and Private sector. BAHA has its offices at: Corner of Forest Drive and Hummingbird Highway, Belmopan, Cayo District.

BAHA has four Departments: (1) Animal Health, (2) Plant Health, (3) Food Safety; and (4) Quarantine. This has as its mission to provide animal health, plant health, quarantine and food safety services that protect human health, animal health and welfare, plant health and the environment, ensure safe and wholesome food, strengthen national food security and facilitate trade and commerce (Source: https://baha.org.bz/about-us/mission-and-vision-statements/). The Quarantine Department includes the Sanitary and Phytosanitary Enquiry Point and the Plant Health Department is responsible for protection against invasive pests and diseases. The Quarantine Department monitors the entry of any disease or pest at the ports of entry. The Plant Health Department also conducts field diagnostics through on - site inspections to investigate crop pests and diseases at the field level; and maintains a database on the health of crops in Belize. Through field inspections by the Plant Health Department, BAHA then certifies commodities for export.
Some of the guidelines for the application of import permits include:

1. Import Permit Applications must be received at least 7 days prior to placing an order for purchase of a plant or plant product.
2. For low- risk commodities permits are issued within seven (7) days of receipt of the application. Importers are asked to submit complete applications including contact numbers so that any issues regarding the application may be communicated without delay.
3. Conditions attached to an Import Permit must be adhered to fully by the exporting country. Failure to do so may result in additional fees being charged to the importer or the product being denied entry.
4. Risk analyses must be conducted for plant or plant products being requested for importation.
5. For certain high - risk commodities there may be a need to conduct on site (at origin) verifications of a phytosanitary nature. The cost of such procedures must be borne by the Importer/Exporter as well as any other relevant fees as indicated by BAHA.
6. Compliance agreements, of a phytosanitary nature, for post entry follow-up of imported commodities may be requested prior to issuance of a permit.
7. Approval of Import Permits for certain commodities may require clearance/approval as dictated by national committees or authorities in accordance with local or international law, regulations, standards, conventions or agreements. Such procedures may delay the issuance

of permits by BAHA or may result in BAHA denying a request for importation. Source: BAHA web site: http://www.baha.bz/plant_health.html.

The Pesticides Control Board (PCB) was legally established by the Enactment of the Pesticides Control Act, Chapter 216 Revised Edition 2020 of the Substantive Laws of Belize. The PCB is a Statutory Body within the Ministry of Natural Resources and Agriculture. The Board is comprised of an inter-sectoral body with representation from various agencies, which are represented in several committees. The PCB is charged with the comprehensive control of pesticide importation and use in Belize. The Board meets regularly to decide matters such as registration and policy Direction. It has a secretariat whose function is to conduct the decisions and administrative activities of the Board. The PCB has its offices at Central Farm, Cayo District.

The functions of the Board are as follows:

(i) Registration of pesticides,

(ii) Licensing of pesticides imports and manufacture,

(iii) Authorization for sale of restricted pesticides,

(iv) Registration of premises for sale of restricted pesticides,

(v) Authorization for use of restricted pesticides,

(vi) Classification of pesticides, and;

(vii) All other aspects of pesticide manufacture, importation, packaging, preparation for sale, disposal and use.

In addition to keeping a register of pesticides, the law allows the PCB to keep a register of licenses which has the name of persons having licenses under the act, a register of authorized persons and authorized premises who are allowed to manufacture or import restricted pesticides, and a register of applicators who are allowed under the act to apply restricted pesticides. Those premises or persons wanting to manufacture, import or sell pesticides are required to apply for a license to do so in specified forms specified in the consolidated laws listed below.

With these requirements above, the company will be required to apply for the license to import or use and apply registered and restricted pesticides on the farm.

The Registered and Restricted Pesticides (Manufacture, Imports and Sale) Regulations detail the fees charged when applying for a license to manufacture, import, or sale of registered and restricted pesticides. The application forms are outlined in the schedule to this regulation. This regulation also has the forms to keep as part of the registrar of licenses, pesticides and a list of registered persons and premises authorized to import and sell registered and restricted pesticides.

3.3.4 The Ministry of Natural Resources, Petroleum and Mining

This Ministry has some key responsibilities as follows: Land and Land Management, Land Surveys, Mining, National Integrated Water Resource Authority, Physical Planning (all subdivisions), Solid Waste Management (Through the Solid Waste Management Authority – SWAMA), and Water Industry (except water supply and services). The Department of Mines and Minerals is a Department of the Ministry of Natural Resources that regulates licenses and permits for mining and extraction of soils and minerals, among other responsibilities.

3.3.5 The Ministry of Blue Economy and Marine Conservation

This Ministry has responsibilities about the Blue Economy such as: defining policies and legislation, coordinating multi-sectoral partners to ensure inclusion, greater partnerships, and networking for greater impact to maximize the use of the oceanic resources for economic development.

3.3.6 The Ministry of Infrastructure Development and Housing

The Ministry of Infrastructure Development & Housing has responsibility for the Central Building Authority, which is responsible for providing permission to construct buildings after the plans have been reviewed and approved.

The Central Building Authority (CBA) is a Statutory Body, whose mandate is to regulate and enforce the Belize Building Act. It is responsible for reviewing building plans for safety, structural stability, and constructability; issuing permits for construction; monitoring and enforcing construction regulations; conducting inspections and site visits to ensure compliance with regulations; and providing technical support and guidance to facilitate the continuation of construction within the country. Any new buildings on the site will require meeting the approval of the CBA.

3.3.7 The Ministry of Tourism, Youth, Sports and Diaspora Relations

Responsible is responsible for Policy and Legislating Development related to the tourism sector. The Belize Tourism Board (BTB) is a statutory body designed to govern, enhance, and promote the Belize tourism product. The BTB develops strategic initiatives as well as the implementation of tourism policies to address the changing needs of the tourism industry while ensuring the socio-economic growth of Belize through prudent, transparent, and effective governance. This agency is mentioned here because of the arrangements made between the landowners of the project and the tourism/conservation body using part of its land for caving and birding activities.

3.4 Legal And Regulatory Framework

This section outlines the current legislation and regulations that pertain either directly or indirectly to the regulation of the subdivision and also other legislation and policy related to the use and management of Belize's natural resources and serves to guide environmental planning and development before and during project implementation. The principal legislative review centred on those as implemented by the Department of the Environment. These include the:

a) Environmental Protection Act, Chapter 328, Revised Edition 2020,
b) Environmental Protection Act, Revised Edition 2020, (Commencement Order), Environmental Impact Assessment Regulations,
c) Environmental Protection Act Chapter 328 Revised Edition 2020, "Chapter 238 Pollution Regulations".
d) Environmental Protection Act, Revised Edition 2020, (Environmental Protection (Effluent Limitations) Regulations.
e) Environmental Protection Act, Revised Edition 2020, Environmental Protection (Hazardous Waste) Regulations.
f) Mines and Minerals Act, Chapter 226 Revised Edition 2020
g) Forest Act Chapter 213 Revised Edition 2020
h) Agriculture Fires Act Chapter 204 Revised Edition 2020
i) Belize Agriculture Health Authority Act, Chapter 211 Revised Edition 2020
j) Pesticides Control Act, Chapter 216 Revised Edition 2020

3.4.1 The Environmental Protection Act, Chapter 328, Revised Edition 2020

This Act legally established the Department of the Environment (Section 3). Under section 3 (3) the Department has the responsibility to monitor the implementation of the Act and Regulations and to take necessary actions to enforce the provisions of the Act and its Regulations. This enabling legislation provides the Government and the Department with the comprehensive environmental protection authority it needs to address modern environmental management issues.

The Environmental Protection Act, Revised Edition 2020, (Commencement Order), **Environmental Impact Assessment Regulations.** This legislation legally establishes and defines the EIA process and describes the schedules where the types of investment are categorized, which determines the level of study to be prepared. "Schedule I" projects require a full EIA while Schedule Two projects require a LLES. The proposed project for which this EIA is being prepared falls under "Schedule I" of the EIA Regulations, thus requiring that an EIA to be prepared herein.

Environmental Protection Act Chapter 328 Revised Edition 2020 of the Substantive Laws of Belize, "Chapter **238 Pollution Regulations**". Among other things, this act calls for companies and investments to apply adequate solid waste management practices as per Regulation 35 (prohibition of disposal of waste) and Regulation 36 that requires companies to establish a waste management plan. It also makes provisions for air particulate matter to be monitored and kept within the levels of the schedules, depending on the type of industry. This regulation also applies the level of noise as per the type of establishments and the location of such establishments.

The Environmental Protection Act, Revised Edition 2020, **(Environmental Protection (Effluent Limitations) Regulations**. This legislation calls for the treatment of effluent to acceptable standards and reporting requirements of the said law; and as per the "First Schedule", "Second Schedule" or "Third Schedule" as described in S.I. 102 of 2009. The Second Schedule "effluent Limitations for Other Industries or Commercial Activities" applies to those not applicable to the industries listed in the first schedule. Since the SLCCL project will produce effluent that is classified as agriculture production in nature, the discharge limits of the Third Schedule discharge into Class I waters apply.

The Environmental Protection Act, Revised Edition 2020, Environmental Protection **Hazardous Waste Regulations**. Regulation 10 of this regulation states that a person storing hazardous waste shall do so with the approval of the satisfactory approval of the Chief Environmental Officer. The guidelines allow for the safe storage of hazardous materials, including the use of a secondary containment system, with labels and warning signs where necessary. Regulation 15 prohibits the disposal of liquid hazardous waste in a landfill. Regulation 12 (1) Requires those transporting hazardous waste to obtain a permit from the Department of the Environment.

Regulation 19 (b) contains a list of substances prohibited from being disposed of in a landfill.
The Environmental Protection Act, Chapter 328, Revised Edition 2020, Environmental Protection (Prohibition of the Open Burning of Refuse and other Combustible Matter) Regulations. This regulation prohibits the burning of refuse and waste from domestic or industrial sources during the time of declaration of a period of public emergency when declared by the Governor General of Belize.

The Refrigeration Technicians (Licensing) Act Chapter 149:01, Revised Edition 2020, calls for the certification of technicians involved in the refrigeration service. A list of certified technicians is kept who are legally registered to serve as refrigeration technicians.

3.4.2 The Mines and Minerals Act, Chapter 226 Revised Edition 2020

The act authorizes the Minister to issue mineral rights to individuals or companies, under specified conditions. Applications for mineral rights are to be published in newspapers and in the Government Gazette for three consecutive weeks to allow the public to review and submit objections, if any to the application.

The act allows for reconnaissance licenses, exclusive prospecting licenses and mining licenses. Mining licenses are issued for three years, and these are subject to renewal, as necessary.
The act also regulates the mining of construction materials produced at quarries, and these are subject to Regulation 79, which makes provisions for the granting of a quarry permit. Quarry permits are to be renewed annually in December of each year. Royalties are to be paid to the

Government for the mining of construction materials and other minerals. The act also makes provisions for protection of the environment through remediation of mined areas, and through the EIA process.

SLCCL project has set aside various hills that may be used in the future for mining. These activities will require that environmental clearance be obtained separately for any new mining operations and that the company applying to conduct any mining or quarrying activity do so in accordance with the necessary legal processes as stipulated in this section.

3.4.3 The Forest Act Chapter 213 Revised Edition 2020

This act empowers the Forest Department through the Minister responsible for forests to declare Forest Reserves, and to implement measures for the management of forest resources.
Regulations 5 and 9 may apply to private lands for the protection of trees, the control of land clearing for cultivation and for the control of fires. In the case of salvaging, the owners are required to apply for a salvage license. In the case of the lighting of fires, this also requires the application for approval to light a fire.

The Forest Act Chapter 213 Revised Edition 2020 of the Substantive Laws of Belize (Consolidation Regulations). The consolidated orders include the following regulations:

a) Forest Reserves (Consolidation) Order
b) Forest (Protection of Trees) Regulations
c) Forest (Export Duty) Order
d) Forest Rules
e) Forest Licenses (Delegation of Powers) Order
f) Forest (Protection of Mangroves) Regulations
g) Application of Act to Private Land Order
h) Powers of Forest Officers Proclamation
i) Forest Roads Regulation

The Forest Reserves (Consolidation) Order contains the designated declared forest reserves and their respective boundary descriptions.

The Forest (Protection of Trees) Regulations have the details for the application of the harvesting of forest produce. This includes the fees and forms as specified under the various schedules to the regulation. The first schedule has the categorization of the various hardwoods in Belize. The permit to convert trees into timber is set forth in the Third Schedule to the Regulation. However, as mentioned earlier there are no plans to harvest forest produce by the company.

3.4.4 Agriculture Fires Act Chapter 204 Revised Edition 2020

This act requires persons or entities desirous of lighting fires for agriculture purposes to apply to the Agriculture Department prior to doing so. In light of the past dry season which saw a significant increase and damage from forest fires, it is important for the private sector engaged in agriculture to comply with this act. Section 3 of the act states that every person desirous of setting fire on land shall apply in writing or in person to the authorized officer for a license to do so and shall state in his application the location and extent of such land and the reasons why, in his opinion, burning is necessary or justifiable (Agriculture Fires Act Chapter 204 Revised Edition 2020, of the Substantive Laws of Belize). The Schedule labelled as Section Four has a copy of the specified application form for a license to set fire on land.

3.4.5 The Pesticides Control Act, Chapter 216 Revised Edition 2020

This act established the PCB as a Statutory Body within the Ministry of Natural Resources and Agriculture with responsibility for comprehensive management of pesticide importation, manufacture, sale and application in Belize.

The Pesticides Control Act, Chapter 216 Revised Edition 2020 of the Substantive Laws of Belize includes the consolidation of the various regulations under this act as follows:

a) Registered and Restricted Pesticides (Uses, Restrictions and Precautions) Regulations,
b) Registered and Restricted Pesticides (Manufacture, Imports and Sale) Regulations,
c) Registered and Restricted Pesticides (Registration) Regulations, and;
d) Restricted Pesticides (Certified User) Regulations.

The Registered and Restricted Pesticides (Uses, Restrictions and Precautions) Regulations contains the list of registered and restricted pesticides in (Regulation 4).

The Registered and Restricted Pesticides (Manufacture, Imports and Sale) Regulations details the fees charged when applying for a license to manufacture, import, or sale of registered and restricted pesticides. The application forms are outlined in the schedule to this regulation. This regulation also has the forms to keep as part of the registrar of licenses, pesticides and a list of registered persons and premised authorized to import and sell registered and restricted pesticides.

The Registered and Restricted Pesticides (Registration) Regulations contains the detailed requirement for the registration of a pesticide for distribution and use in Belize.
The Restricted Pesticides (Certified User) Regulations contain detailed regulations for the issuing of a certificate to a certified pesticide user. A user's license shall be accompanied by an application fee of $5.00 (Regulation 6). The application forms are detailed in this act as well as the form for the certificate to be issued

The Restricted Pesticides (Certified User) Regulations contain detailed regulations for the issuing of a certificate to a certified pesticide user. A user's license shall be accompanied by an application fee of $5.00 (Regulation 6). The application forms are detailed in this act as well as the form for the certificate to be issued.

3.4.6 The Belize Agriculture Health Authority Act, Chapter 211 Revised Edition 2020

This act established the Belize Agriculture Health Authority (BAHA) as a statutory body. Under the guidance of its Board of Directors, this statutory body has as its mission to provide animal health, plant health, quarantine and food safety services that protect human health, animal health and welfare, plant health and the environment, ensure safe and wholesome food, strengthen national food security and facilitate trade and commerce (Source: https://baha.org.bz/about-us/mission-and-vision-statements/).

3.4.7 National Integrated Water Resources Act Chapter 222.01 Revised Edition 2020

PART III of the Act is dedicated to the overarching national policy, more specifically section 15 subsection (1), which states, "….the policy of the Government for the orderly and coordinated development and use of Belize's water resources, to conserve and protect such resources for the benefit of present and future generations of Belizeans, and to provide the Belizean public with a safe, adequate and reliable supply of water."

This new legislation recognizes the roles of the various institutions involved with the management of Belize's water resources and the various legislations administrated by these agencies allowing for a more nationally coordinated and integrated management approach, through the establishment of the National Water Resources Authority. However, the implementation of the new Act has remained somewhat dormant since its enactment in 2011.

The executive arm of the National Water Resources Authority is the Hydrology Unit, which has been split from the Meteorology Department where it was once programmatically located. PART V of the act deals with the abstraction and use of water. Regulation 25 states that "the abstraction and use of water in Belize and the construction of any works for such abstraction and use shall be governed by the provisions of this Act." Regulation 27.- (1) goes on to state that "a person may abstract and use water without a license if the water is required for the following purposes,

(a) domestic use;

(b) agricultural use, which does not include flood irrigation;

(c) any other purpose which the Authority may prescribe."

However, the act requires that a permit be required for the abstraction of ground water by means of wells. Although the project proponents intend to conduct rain fed crop production, the irrigation of crops is an open option and the present Act does not restrict them from using the Sibun River if in the future, they desire to conduct irrigation of any of the crops.

3.5 Summary of Regulatory Framework And Fees For Violations

Table 28 below summarizes the legally required fines for non - compliance with various laws and regulations.

Table 28: Summary of permits and penalties.

Agency	Legislation/License Permit	Penalties and Fines
Department of The Environment	Environmental Protection Act (Commencement Order), Environmental Impact Assessment Regulations, Revised Edition 2020 and Environmental Impact Assessment Regulations, Environmental Impact Assessment (Amendment) Regulations)	Section 22 of the consolidated amendments (Act no. 18 of 2015) states that: Any person who fails to carry out an environmental impact assessment or any conditions imposed by the Department or fails to execute its Environmental Compliance Plan as required under this Act or any regulation made thereunder commits an offence and shall be liable on summary conviction to a fine of not less than fifty thousand dollars and not exceeding one hundred thousand dollars or to imprisonment for a term not exceeding two years or to both such fine and imprisonment.
Department of The Environment	Environmental Protection Act Chapter 328 Revised Edition 2020 of the Substantive Laws of Belize, "Chapter 238 Pollution Regulations" Act No. 18 of 2015 which are the consolidated amendments.	Act No. 18 of 2015 also states in Section 11 (1): No person shall emit, import, discharge, deposit, dispose of or dump any waste that might directly or indirectly pollute water resources or damage or destroy marine life. Any person who contravenes Section 11 subsection (1): commits an offence and is liable on summary conviction to a fine not less than five thousand dollars and not exceeding twenty-five thousand dollars or to imprisonment for a period not exceeding two years or to both such fine and period of imprisonment, and to a further fine not exceeding one thousand dollars a day for every day that the offence is continued after a notice by the duly designated officer requiring him to cease the act specified therein has been served upon him.

Agency	Legislation/License Permit	Penalties and Fines
		Section 13 (1) also prohibits the dumping of garbage, hazardous waste, refuse and other toxic substances that may pollute the environment or water resources and may damage or destroy flora and fauna. Any person who contravenes sub-section (1) commits an offence and is liable on summary conviction to a fine not exceeding twenty-five thousand dollars or to imprisonment for a term not less than six months and not exceeding five years, or to both such fine and imprisonment.
Department of The Environment	Hazardous Waste Regulations 2009	Any person who commits an offence under is liable on summary conviction to a fine not more than ten thousand dollars or/and two years' imprisonment.
Central Building Authority	Belize Building Regulations, Chapter 131 Rev. Ed. 2020 Building Permits and Control	20.–(1) Where a person carries out any work without a permit or does any act or fails to do an act in contravention of this Act or regulations made, the Director or a Building Unit may issue an order in writing, called a "Stop Order", to such person directing him to cease, by a date specified in the order, the activities specified in the order. (2) Where a person to whom an order is issued under sub section (1), fails to take appropriate steps to ensure the cessation of the activity to which the order relates, he commits an offence and is liable on summary conviction to a fine not exceeding five thousand dollars or to imprisonment for a term not exceeding five years or to both such fine and term of imprisonment.

Forest Department	Forest salvage license	Any person found liable can be fined a fine not exceeding ten thousand dollars or imprisonment not exceeding twelve months, or both such fine and term of imprisonment. The unlawful possession of forest produce has a prescribed value as specified in Schedule 11 of the Forest Act, Chapter 213 Revised Edition 2020 of the substantive laws of Belize.
	Mangrove Forests-Protection-of-Mangroves-Regulations-2018	(1) Any person who contravenes or aids in the contravention of any of the provisions of these Regulations that would or are intended to protect mangrove stands from damage or destruction, or a condition of a permit issued under these Regulations, commits an offence and is liable on summary conviction to a fine not exceeding twenty-five thousand dollars, or to imprisonment for a term not exceeding twelve months, or to both. (2) In addition to any sentence imposed under subsection (1), the court may order the cancellation of any permit granted under the provisions of this Regulation and the forfeiture of any vehicle, vessel or other means of transport or equipment used in the commission of the offence. (3) All objects forfeited shall, with the approval of the Minister, be disposed of by the Department in such manner as the Minister may prescribe . (3) When any person has been convicted of an offence, the court may, in addition to any other penalty provided under this Regulation, assess the amount of any damage which may have been caused by the offender and cause the same to be recovered in such manner as if it were a civil penalty and without limit of amount or, in the case of unauthorized structures or clearance, may order the removal of the same within such period as it may specify, and the restoration of each location of the damaged area as nearly as possible to its previous condition.

Agriculture Department Agricultural Fires Act Chapter 204 Rev. Ed. 2000	Application for license to set a fire for agriculture purposes or clear land for cultivation needs to make a fire trace around the said land.	Every person who- *(a)* sets fire on, or procures, or aids the setting fire on any land without a license; or *(b)* clears, procures, aids the clearing of any land in contravention of section 7, commits an offence and is liable on summary conviction to a fine not exceeding five hundred dollars or to imprisonment for a term not exceeding six months, or to both such fine and term of imprisonment. 9. Nothing contained in this Act shall take away or diminish the liability of any person for any damage from fire caused by the act or neglect of such person or his servant and nothing in this Act shall take away or diminish the liability of any person to prosecution and punishment for an offence at common law or under any other law of Belize; but no person shall be punished twice for the same offence.
Pesticides Control Board (PCB) Rev. Ed. 2000	Application and Registration of any pesticide License	Every person who knowingly- (a) contravenes any of the provisions of this Act, or any regulations made thereunder; or (b) with intent to deceive- (i) forges or uses or lends to or allows to be used by another person any licence or certificate issued pursuant to this Act; or (ii) makes or has in his possession any documents so closely resembling such licence or certificate as to be calculated to deceive; or (c) assaults or obstructs any inspector or other officer designated or appointed as the case may be under this Act, acting in the performance of his functions pursuant to this Act; or (d) without proper authority interferes with, or disposes of, any article seized or detained pursuant to paragraph (d) of subsection (2) of section 17; or

		(e) bribes or attempts to bribe any inspector or other officer designated or appointed as the case may be under this Act, in connection with any matter arising in the performance of any of his functions pursuant to this Act; or (f) being an inspector or other officer designated or appointed under this Act as the case may be, accepts or solicits any bribe in connection with any matter arising in the performance of any of his functions pursuant to this Act, commits an offence and shall be liable on summary conviction before a magistrate to a fine not exceeding one thousand dollars or to imprisonment for a term not exceeding twelve months or to both such fine and imprisonment.
Belize Agriculture Health Authority (BAHA) Rev. Ed. 2011	BAHA has a comprehensive fee structure for services and approval for importation of goods and products as well as for the certification of facilities and the testing of produce by its veterinary diagnostic laboratory. These are detailed in the Belize Agriculture Health Authority (Service Fees) Regulations. It also includes the cost of risk analysis to be done by individuals or companies.	In addition to confiscation of products not having met the BAHA requirements, there are fees for violations including "Any person who commits an offence against this Act shall, save where otherwise expressly provided, be liable for each such offence on summary conviction to a fine of not less than two thousand dollars and not exceeding ten thousand dollars or to imprisonment for any period not exceeding three years." The importation of commodities without the proper documentation are held until these are produced.

3.6 Relevant Principal Legislation and Status of Compliance

Table 29 below describes the design, taking into consideration the degree of adherence to environmental laws, administrative issues, and guidelines, highlighting any shortcomings where relevant, and offering suggestions for changes or corrections at the local and national levels governing environmental quality that are in line with the proposed project.

Table 29: Key legislation and actions to be addressed by project implementation.

Name of Law	Action Required	Action Adopted/ Standards Secured	Status of Implementation
Environmental Impact Assessment Regulations	Environmental protection through subsidiary legislation outlined herein	EIA Being Prepared	EIA in advanced stage /progress
Environmental Protection Act Chapter 328 Revised Edition 2020, (Environmental Protection (Effluent Limitations) Regulations	Treatment of domestic effluent to acceptable standards and reporting requirements as per Regulation six (6) of the law and as per the "Third Schedule" of S.I. 102 of 2009, (Discharge from domestic wastewater treatment systems into Class II waters). Regulations 23 (Provisions for sampling test points); and Regulation 25 (Render assistance during inspection).	Baseline data established and Monitoring Plan drafted in EIA. As per "Third Schedule" of the S.I. 102 of 2009 Amendment Regulations (Discharge into Class II Waters). Since the effluent produced is from domestic sources and not from industrial or commercial effluent production, no effluent license is required. However, Provisions for monitoring, inspection and reporting Regulations 15, 23 and 25) are being met through the reporting process of the company. Effluent standards are expected to fall within the set limits of the Third schedule.	Monitoring plan to be followed after EIA approval and signing of ECP.
Environmental Protection Act Chapter 328 Revised Edition 2020 of the Substantive Laws of Belize, "Chapter 238 Pollution Regulations".	PART X Pollution of Land Pollution of land generally. Waste management to prevent pollution.		Draft solid waste plan included in EIA
Environmental Protection Act, Revised Edition 2020, Environmental Protection Hazardous	Regulation 10 states that a person storing hazardous waste shall do so with the satisfactory approval of	As part of the chemical management plan, the company shall keep a List of all chemicals used for	Chemical management plan drafted as part of EIA.

Waste Regulations.	the Chief Environmental Officer. The guidelines allow for the safe storage of hazardous materials, including the use of a secondary containment system, with labels and warning signs, if necessary. Regulation 15 prohibits the disposal of liquid hazardous waste in a landfill. Regulation 12 (1) Requires those transporting hazardous waste to obtain a permit from the Department of the Environment. Regulation 19 (b) contains a list of substances prohibited from being disposed in a landfill. Tables 1, 2 and 3 of the Schedule of this regulation contain a list of Discarded goods, containers and listed waste streams relevant to the regulations. Regulation 23 requires the classification of hazardous waste being generated in a manner approved by the Chief Environmental Officer. Crop Protection Guidelines	domestic purposes (cleaning and sanitation); flammable substances such as fuels and oils; lubricants, (some under pressure within containers) as well as oils and greases used in heavy equipment. These substances have been classified as hazardous, and non - hazardous, with warning signs installed for those with potential hazards to humans. The environment suitable posted. All substance in very low amounts, not exceeding a few gallons. Crop protection guidelines are to be followed.	Crop protection guidelines recommend process for cleaning, storing and preparation of pesticides containers for final disposal and recycling.
Solid Waste Management Authority Act (Chapter 224) Revised Edition 2020	While the act does not specify any regulations dealing directly with solid waste generated by privately held facilities, these establishment are required to properly dispose of their waste	Solid waste management plan is in place.	Solid waste management plan has been prepared in EIA and to be adopted, reviewed and improved, when necessary.

	materials. For the project, this entails the domestic portion of waste as well as all categories including construction, biomass, and other waste streams that must be disposed of properly.		
Public Health Act Chapter 40 Revised Edition 2020	The agency has power to inspect all buildings to ensure public health issues such as sanitary disposal of sewage and other waste is done	Adequate sanitary facilities (Toilets, drinking water, etc.) provided throughout the compound.	Sanitary facilities have been installed.
Mines and Minerals Act, Chapter 226 Revised Edition 2020	The Mining Unit issues permits and licenses as well as designated mineral rights. It regulates the operations of quarries via Regulation 79 which has the process for the issuing of a quarry permit.	The company has set aside property where quarry material may be obtained in the future. At this time there are no plans for quarrying.	At the time of quarrying in the future, the company will be required to undergo the application process to operate a mine for the production of construction material.
Pesticides Control Act, Chapter 216 Revised Edition 2020	Pesticides Control Board (PCB) regulations the importation, manufacture, distribution and application of registered and restricted pesticides.	Any registered or restricted pesticide acquired by the company will require the application for importation (if the product will be imported), and the approval of facility for its storage as well as the securing of licenses for its use.	There are no registered or restricted pesticides required on site at the time of writing. The need for this will trigger the approval process in writing.
Belize Agriculture Health Authority Act, Chapter 211 Revised Edition 2020	BAHA has a comprehensive process for the certification of agriculture produce to be exported.	The approval process for exportation or sale of produce is done via the other companies that receive products. However, if SLCCL agriculture producers need to export directly they will need to apply for all relevant permits and approvals.	No need for new applications at this time.
Forest Act Chapter 213 Revised Edition 2020 of the Substantive Laws of Belize (Consolidation Regulations).	The Forest Department is the legally authorized agency to control timber and forest produce extraction and production.	There is no forest produce with sufficient timber value for commercial use.	There is no need for any permits at this time. No salvaging is planned as the forest produce are

			not of any significant value.
Agriculture Fires Act Chapter 204 Revised Edition 2020	The Department of Agriculture has the legal authority for the processing of permits to light agriculture fires.	One method of elimination of debris and biomass as part of land preparation is to burn the vegetation. This requires the application of a permit.	A permit for the use of fire as a means of land clearing for agriculture may be applied for if this will be done. The area has enough open areas as buffer to eliminate fire risks.

CHAPTER 4 IMPACTS TO FLORA AND FAUNA

4.1 Vegetation And Ecosystems

4.1.1 Introduction

The natural vegetation in SLCCL (previously known as Tiger Sandy Bay) property reflects the geology and hydrology of the terrain. The vegetation can also be grouped into distinct ecosystems. Vegetation types/ecosystems are typically found to be arranged around distinct geological and hydrological features. The more relevant of these have been presented elsewhere in this report. Repeated naturogenic disturbances such as hurricanes, and anthropogenic events such as wildfires, and logging, have also influenced the development of these ecosystems. Within the SLCCL property, land use change (and to a certain extent land use planning), has been guided for the most part by the

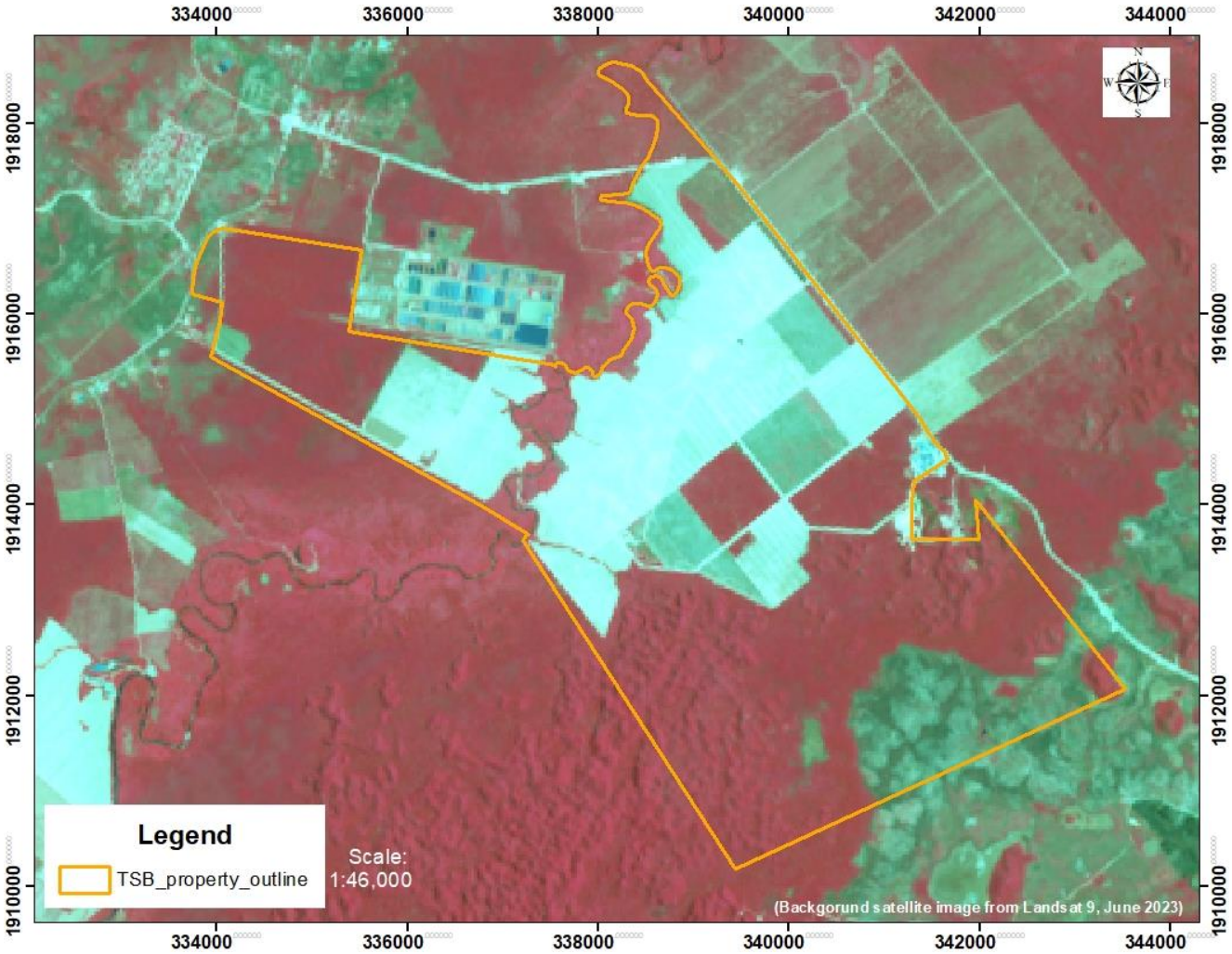
potential of geology and soils, where natural ecosystems have been replaced with cultivated crop systems and quarrying. Consequently, most of the natural ecosystems on the SLCCL property have been reduced in area by land use change to agriculture and quarrying.

4.1.2 Methodology

The methodology employed in conducting the terms and objectives of this study relied on the relevant proven and much used protocols that have been used to conduct floral and faunal surveys at the required intensity. Planning for information gathering in the field was informed by bibliographical research, remote sensing imagery, and personal communications.

The availability of good resolution satellite imagery has greatly enhanced our capacity to assess vegetation cover. Although different satellite imageries were used in this assessment, the scenes from Landsat 9 at a moderate resolution of 15 meters provided a clear image of the study area for the purpose of determining natural vegetation cover and changes in land use over time (Figure 28).

Natural vegetation ecosystem for Belize were mapped in 2001 and periodically updated since (Meerman and Sabido, 2001, Meerman and Sabido 2017). This ecosystem map therefore forms the basis for vegetation type mapping in the SLCCL property.



(Dark red colours indicate dense broadleaf vegetation, bluish-green colour represents open vegetation, including savannas, white colour represents areas completely bereft of vegetation.)

Figure 28: Landsat 9 satellite image of the SLCCL property.

However, changes in the composition of vegetation populations that have occurred over time can only be verified by on the ground field visits and assessments. For example, the area of SLCCL has been subject to at least three hurricanes in the last two decades or so (Richards-2010, Earl-2016, Lisa-2022) and the wildfires that normally occur in these hurricane-impacted areas during the subsequent dry season has also had an impact on the ecosystems in SLCCL. Extreme climate change related fire weather has also contributed to the occurrence and intensity of wildfires in the area. In April 2024, the pine savannas in the area of SLCCL experienced annual wildfires (most if not all of anthropogenic origin) but in May wildfires had spread to the adjoining broadleaf vegetation where wildfire is not a frequent occurrence. It should also be noted that the flora and

fauna in representative ecosystems found in adjoining properties particularly those forming part of the Central Biological Corridor have been the subject of continuous study and monitoring.

This data has greatly informed the current assessment of the ecosystems represented in the SLCCL property. The main ecosystems identified were visited and where relevant an assessment of the species present was made by establishing on the ground standardized transects in order to assess current species composition, diversity and vegetation structure, although it was not considered necessary to assess all ecosystems.

The methodology used for the vegetation transects has been adapted from the methodology used by the Forest Planning and Management Project in Belize (Shawe, 1997) and subsequently adapted by Meerman (Meerman, 2003). This methodology involved opening of a 200-meter-long line just wide enough to provide access through the vegetation and minimizing the unnecessary removal of any vegetation. A 2-meter band on each side of the cutline was continuously surveyed thus effectively covering a transect survey area of 200 meters by 4 meters. In this transect, all trees with a diameter at breast height (dbh) or 1.3 meters vertically from the ground of 10 centimetres or more are counted, measured and where possible identified. Only those stems that had their base within the transect (important in the case of leaning trees) were counted. All other herbs, vines, saplings, shrubs etc. were identified to the closest level possible. It should be noted that many plants cannot be identified to species when not in flower and/or fruit. Data gathered from each tree measured included the following:

a) Common name
b) Scientific name
c) Stem height
d) Crown form
e) Canopy closure
f) Dead trees
g) Description of understory and identification of understory species at the start and end of every 100-meter point

A total of nine (9) transects were surveyed. The data obtained allows the assessment and calculation of biodiversity in the property. It is universally accepted that vegetation is the basis for terrestrial ecosystems and biodiversity. Therefore, by extension floristic biodiversity is a good proxy for overall ecosystem biodiversity.

4.1.3 Results

Three **(**3) natural vegetation ecosystem classes were identified within the SLCCL property. (See Figure 29) These are:

a) **Lowland broad-leaved moist forest**
b) **Lowland broad-leaved moist scrub forest**
c) **Lowland savanna**

The lowland broad-leaved moist forest accounts for 57% of the remaining natural vegetation cover on the SLCCL property and once covered a large portion of the area presently converted to agricultural use. The vegetation surveys conducted within SLCCL confirmed a complex matrix of ecosystems each with their typical array of associated species. These ecosystems tend to transition into one another, making it impossible to accurately draw distinct boundaries between them.

This broad ecosystem class is further subdivided into three distinct ecosystem types. Their original description as per Meerman and Sabido (Meerman and Sabido, 2001) is provided in Table 30. See Appendix VI: Guide to Interpret the Ecosystem Description Tables.

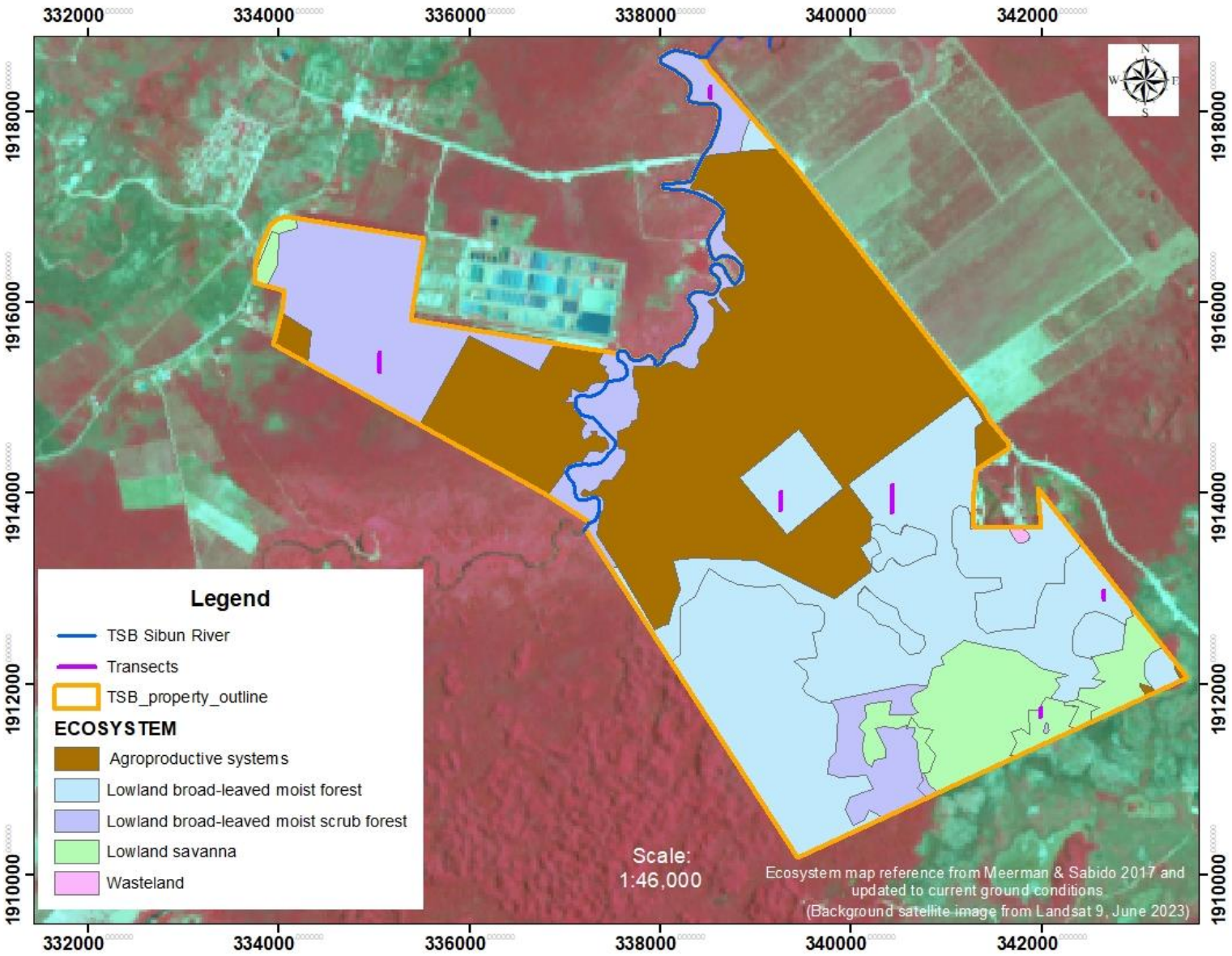


Figure 29: Broad ecosystem classes in the SLCCL property.

4.1.3.1 Tropical evergreen seasonal broadleaf lowland forest over poor or sandy soils

The ecosystem represented by Tropical evergreen seasonal broadleaf lowland forest over poor or sandy soils will also remain as one of the largest portions of the 1,649 acres of conservation land in the SLCCL land use zoning plan. Although this ecosystem is considered a broadleaf forest, it can often include Caribbean Pine trees and is considered a transitional forest.

Table 30: Tropical evergreen seasonal broadleaf lowland forest.

Legend Code	**29**
UNESCO Classification code	**I.A.2.a.(1).(b).S**
Name	**Tropical evergreen seasonal broadleaf lowland forest over poor or sandy soils (Broken ridge)**
Altitude	< 100 m.
Geology and soil	Nutrient poor, acidic soils
Water regime	Moderately well drained
Rainfall	Average rainfall less than 2500 mm per year with a pronounced dry season from February through May.
Fire exposure	Fire is of at least occasional occurrence in this ecosystem
Description	Medium high forests
Frequent plant species	Characterized by low *Attalea cohune, Acosmium panamense Calophyllum brasiliense, Miconia* spp., *Terminalia amazonia, Virola koschnyi, Vochysia hondurensis* and *Xylopia frutescens*. Other, frequently encountered species include: *Aspidosperma* sp., *Bactris major, Bactris mexicana, Belotia campbellii, Bucida buceras, Byrsonima crassifolia, Chrysobalanus icaco, Chrysophyllum mexicanum, Clidemia* sp., *Coccoloba* sp., *Desmoncus orthacanthos, Guettarda combsii, Hampea trilobata, Hirtella racemosa, Licania hypoleuca, Luhea speciosa, Metopium brownei, Miconia* spp., *Mouriri exilis, Ouratea* sp., *Pachira aquatica, Pinus caribaea, Pouteria* sp., *Psychotria poeppigiana, Roupala montana, Scleria bracteata, Simarouba glauca, Spondias mombin, Tabernaemontana arborea, Tetracera volubilis* and *Trichospermum campbellii.*
Faunistic comments	This is the main habitat for forest species such as Jaguar, tapir, and Great Curassow.
References	Meerman 1999c, Wright et al. 1959: 1, 11a, 11c, 11d, 11e, 11g, Iremonger and Brokaw 1995: I.2.2.4. Picture: *Xylopia frutescens.* Toledo district. J. Meerman

All of the species listed in the chart above were small diameter trees less than 45 cm. diameter at breast height (measured 1.3 m from the ground level) which is the minimum diameter that is considered to be of commercial size (Figure 30). The number of species forming part of the tree overstorey is small. The impression is given of a forest that has experienced severe wind damage in the past as could be observed by windthrown trees and broken crowns, frequent and severe fire as could be observed by charring and other signs of fire damage, and intensive (salvage level) logging as evidenced by the low frequency of commercial species and the absence of commercial size stems in these species. The species found in the understory of the ecosystem is provided in Table 31.

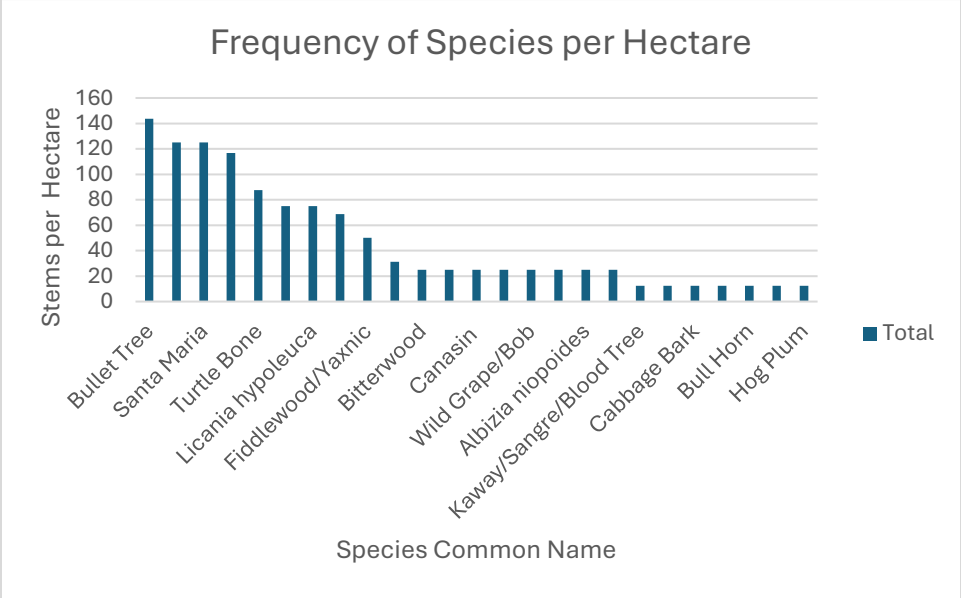


Figure 30: Frequency of species measured in the tropical evergreen seasonal broadleaf lowland forest on poor or sandy soils.

Table 31: List of understory species identified in the ecosystem.

Common Name	Scientific Name
Acanthaceae sp.	*Acanthaceae sp.*
Billy Web	*Acosmium panamense*
Botan	*Sabal mauritiiformis*
Bri Bri	*Inga vera*
Bull Horn	*Vachellia sp.*
Bullet Tree	*Terminalia buceras*
Cohune Palm	*Attalea cohune*
Cutgrass	*Scleria latifolia*
Dog Balls	*Tabernaemontana alba*

Dog Balls	*Thevetia ahouai*
Give-and-Take Palm	*Croysophila stauracantha*
Iron Wood	*Dialium guianense*
Jackass Bitters	*Neurolena lobata*
Leche Maria	*Sapium sp.*
Lianas spp.	*Lianas spp.*
Licania hypoleuca	*Licania hypoleuca*
Myrcia sp.	*Myrcia sp.*
Palmetto	*Acceloraphe wrightii*
Provision Tree	*Pachira aquatica*
Sombra de Ternero	*Cordia bicolor*
Sunflower sp.	*Asteraceae sp.*
Trumpet Tree	*Cecropia peltata*
Turk's cap	*Malvaviscus arboreus*
Turtle Bone	*Zygia cognata*
Vines spp.	*Vines spp.*
Waika Chewstick	*Symphonia globulifera*
Water Orchid	*Aechmea bracteata*
White Gumbolimbo	*Dendropanax arboreus*
Wild Coffee	*Palicourea tomentosa*
Wild Grape	*Coccoloba diversifolia*
Wild Guava	*Eugenia sp.*
Wild Tomatillo	*Solanum sp.*
Yellow Sangre	*Vismia camparaguey*

4.3.3.2 The Tropical evergreen seasonal broadleaf lowland forest over rolling calcareous hills

The Tropical evergreen seasonal broadleaf lowland forest over rolling calcareous hills ecosystem described below (Table 32), covers the higher elevations and steeper topography rising from a flat plain. Its geology gives rise to the formation of caves and the nature tourism potential this may imply. Its geology also provides the potential for mining, particularly for aggregates. It is extremely sensitive to fires, and it constitutes a significant portion of the SLCCL property that has been designated as conservation land.

Table 32: Tropical evergreen seasonal broadleaf lowland forest over rolling calcareous hills.

Legend Code	**19**
UNESCO Classification code	**I.A.2.a.(1).(a).K-r**
Name	**Tropical evergreen seasonal broadleaf lowland forest over rolling calcareous hills**
Altitude	< 500 m.
Geology and soil	Soils over limestone rock.
Water regime	Mostly well drained
Rainfall	Average rainfall less than 2500 mm per year with a pronounced dry season from February through May.
Fire exposure	Fires can do tremendous damage to this ecosystem. The soil at the base of these hills is often quite fertile and sought after for slash and burn agriculture. Agricultural fires associated with this practice frequently escape and creep up the hills, commonly doing relatively minor damage at the lower elevations but completely destroying the tops of the hills.
Description	These forests are distinguished by topography because there are distinct differences between the lowland forests in Belize and those covering the hills probably as a result of differences in drainage. These forests display characteristics intermediate between lowland tropical forests and the submontane forests of higher altitudes in the Maya Mountains. The canopy trees 15-40 m tall. There is a distinct deciduous element.
Frequent plant species	Common woody plants are; *Acacia dolychostachya, Alseis yucatenensis, Ampelocera hottlei, Annona primigenia, Aspidosperma cruenta, Attalea cohune, Bourreria oxyphylla, Brosimum alicastrum, Calophyllum brasiliense, Casearia bartlettii, Cedrela odorata, Cordia gerescanthus, Crysophila stauracantha, Cupania belizensis, Cymbopetalum mayanum, Exothea paniculata, Guarea glabra, Hirtella americana, Licaria peckii, Lysiloma acapulcense, Manilkara zapota, Sideroxylon foetidissimum, Matayba oppositifolia, Ouratea lucens, Pimenta dioica, Pouteria amygdalina, Pouteria durlandii, Protium copal, Pseudolmedia oxyphyllaria, Rehdera penninervia, Sabal mauritiiformis, Sebastiana tuerckheimiana, Simira salvadorensis, Spondias mombin, Stemmadenia donnell-smithii, Tabebuia guayacan, Trichilia havanensis, Trichilia moschata, Trophis racemosa, Vatairea lundellii, Vitex gaumeri, Wimmeria concolor, Zanthoxyulum procerum, Zuleania guidonia* and Myrtaceae. Palms and Rubiaceae are abundant in the shrub layer and lianas are frequent.
Faunistic comments	

References	Brokaw & Lloyd-Evans 1987, Iremonger & Sayre 1994, Meerman 1998b, Schultze and Whitacre 1999, Wright et al. 1959: 3, 3a, 3b, 4, 4a, 4b; Iremonger and Brokaw 1995: I.2.3.1. Picture: Fruits of *Cedrela odorata*. Cayo district. J. Meerman

4.1.3.3 Tropical evergreen seasonal broadleaf lowland forest over calcium-rich alluvium

The distribution of the ecosystem, Tropical evergreen seasonal broadleaf lowland forest over calcium-rich alluvium described below (Table 33) is very limited, 18.3 acres (7.42 ha) and is a remnant (less than 1%) of a much larger area within the property that not surprisingly has been cleared for agricultural cultivation, given the suitability of these soils.

Table 33: Tropical evergreen seasonal broadleaf lowland forest over calcium-rich alluvium.

Legend Code	**28**
UNESCO Classification code	**I.A.2.a.(1).(b).K**
Name	**Tropical evergreen seasonal broadleaf lowland forest over calcium-rich alluvium**
Altitude	< 50 m.
Geology and soil	Soils are deep, calcium rich and usually sandy.
Water regime	Moderately well drained
Rainfall	Average rainfall less than 2500 mm per year with a pronounced dry season from February through May.
Fire exposure	Limited to areas with slash and burn cultivation.
Description	This very mixed assemblage is found on the middle terraces of many rivers and streams draining from the Maya Mountains.
Frequent plant species	Frequently encountered species are: *Acoelorrhaphe wrightii, Atalea cohune, Bactris major, Bactris mexicana, Belotia campbellii, Calathea lutea, Calophylum brasiliense, Ceiba pentandra, Chrysophyllum oliviforme, Coccoloba belizensis, Coccoloba schiedeana, Costus guanaiensis, Cupania belizensis, Desmoncus orthacanthos, Ficus* sp., *Guarea* sp., *Hampea trilobata, Heliconia latispatha, Luhea speciosa, Lysiloma bahamense, Manilkara* sp., *Maranta arundinaceae, Pimenta dioica, Pouteria* sp., *Pterocarpus rohrii, Sabal mauritiiformis, Samanea saman, Schizolobium parahybum, Simarouba glauca, Spondias mombin, Stemmadenia donnell-smithii, Swietenia macrophylla, Tabebuia rosea, Tabernaemontana arborea, Virola koschnyi, Vitex gaumeri, Vochysia hondurensis, Zanthoxylum* sp., *Zuleania guidonia.* The species are a mixture of lowland, moist dependent and somewhat more drought tolerant species.

Faunistic comments	This ecosystem appears to be a favored habitat for the Yucatan Black Howler Monkey *Alouatta pigra.*
References	Meerman 1999c, Wright et al. 1959: 7; Iremonger and Brokaw 1995: I.2.2.2. Picture: *Ceiba pentandra*. Macal River, Cayo District. J. Meerman

4.1.3.4 Lowland broadleaf moist scrub forest

Lowland broadleaf moist scrub forest cover accounts for 29% of the natural ecosystems remaining on the SLCCL property. This broad ecosystem class can be subdivided into three ecosystems which are described below.

4.1.3.5 Deciduous broadleaf lowland riparian shrubland of the plains

Deciduous broadleaf lowland riparian shrubland of the plains (Table 34) ecosystem describes the riparian vegetation along the banks of the Sibun River as can be observed in Figure 31. This ecosystem is greatly influenced by frequent flooding in which the force of the flood waters of the Sibun River is the source of frequent disturbance uprooting trees and other vegetation. This has led to patches of dense woody and herbaceous shrubs interspersed with stands of fast-growing tree species. It is anticipated that a riparian reserve of at minimum 150 feet will be maintained within this ecosystem.

Table 34: Deciduous Broadleaf Lowland Riparian Shrubland of The Plains.

Legend Code	**60**
UNESCO Classification Code	**III.B.1.b.(f).P**
Name	**Deciduous broadleaf lowland riparian shrubland of the plains**
Altitude	< 50 m.
Geology and soil	On alluvial deposits. Outcrops of calcareous rock occur, but generally the alluvial deposits are deep and there is no bedrock visible.
Water regime	Mostly well drained
Rainfall	NA
Fire exposure	Frequently exposed to human induced fires.
Description	Found along riversides where disturbance may be natural, such as the displacement by a river after flooding, or it may be anthropogenic as when land is cleared and left fallow.
Frequent plant species	Tall graminoids (reeds, rushes, and sedges) mix with shrubs, and many types of ruderal communities.

Faunistic comments	
References	Iremonger and Brokaw 1995: II.2.3.

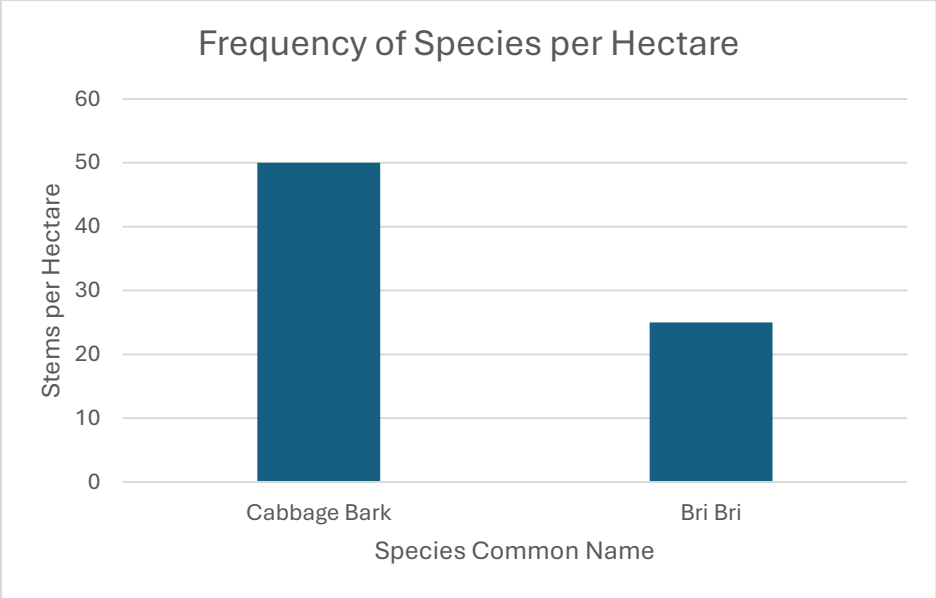


Figure 31: Frequency of species measured in the deciduous lowland riparian shrubland of the plains.

Only two tree species found in this ecosystem had stem diameters large enough to be measured and these were very few and very small sapling and pole size trees. The Bri-Bri tree is a very common riparian species, often achieving its greatest development along the riverbanks. Its understory is known to contain the species listed in Table 35 and as shown in Figures 32 and 33.

Table 35: List of understory species identified in the ecosystem.

Common Name	Scientific Name
Cissus sp.	*Cissus sp.*
Dumb Cane	*Tripsacum latifolium*
Morning Glory	*Odonellia hirtiflora*
Platanillo	*Heliconia sp.*
Pokonoboy	*Bactris major*
Riverside Kaway	*Cordia collococca*
Senna pendula	*Senna pendula*
Sensitive Bush	*Mimosa pigra*
Wild Jicama	*Pachyrhizus ferruginous*

Photo credit: Luis Peña
Transect through an area dominated by Followed by Morning Glory (*Odonellia hirtiflora*) and Wild Jicama (*Pachyrhizus ferruginous*).

Figure 32: Heliconia (Heliconia spp.).

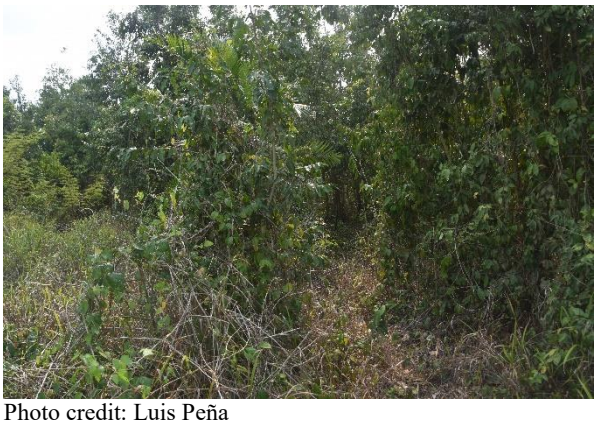


Photo credit: Luis Peña
Transect through an area dominated by Cabbage Bark (Lonchocarpus spp.). Sensitive Bush (*Mimosa pigra)*, and Pokonoboy (*Bactris major*).

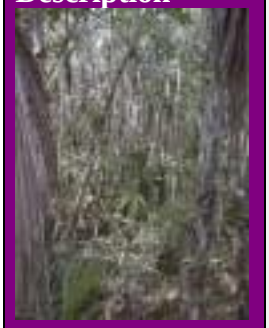
Figure 33: Cabbage Bark (Lonchocarpus spp.).

4.1.3.6 Broad-leaved lowland shrubland

Part of the Broad-leaved lowland shrubland ecosystem within the SLCCL property described below (Table 36) has been converted to agricultural use but the larger portion (approximately 692 acres (280 h.)) remains intact at present. It is zoned for further agricultural development. It is an accompanying ecosystem to the savanna ecosystem and is characterized by very dense woody shrubs and small trees.

Table 36: Broad-leaved lowland shrubland.

Legend Code	**55**
UNESCO Classification code	**III.A.1.b.(a).L**
Name	**Broad-leaved lowland shrubland**
Altitude	< 250 m.
Geology and soil	Soil is a pale gray brown leached layer overlying a gray layer with manganese concretions. A hog-wallow micro-relief occurs.
Water regime	A "perched" water table develops seasonally.
Rainfall	Average rainfall mostly less than 2000 mm per year with a pronounced dry season from February through May.
Fire exposure	Unknown

Description 	This type undergoes extremes of wetting and drying in the course of the year and has a significant complement of deciduous species. The canopy is very level with few or no emergents and only 4-6 m. high. Usually found in association with the IA2g(1)(a) types (Tropical evergreen seasonal broadleaf lowland swamp forest).
Frequent plant species	Frequently encountered species include *Acoelorraphe wrightii*, *Ardisia* sp., *Bucida buceras*, *Byrsonima bucidaefolia*, *Caesalpinia gaumeri*, *Cameraria latifolia*, *Calophyllum brasiliense*, *Chrysobalanus icaco*, *Coccoloba reflexiflora*, *Croton* spp., *Erythroxylum guatemalense*, *Eugenia rhombea*, *Gliricidia sepium*, *Gymnopodium floribundum*, *Haematoxylon campechianum*, *Krguidendron ferreum*, *Manilkara zapota*, *Margaritaria nobilis*, *Metopium brownei*, *Myrica cerifera*, *Ouratea* sp., *Pithecellobium albicans*, *Plumeria obtusa*, *Rapanea guianensis*, and *Swietenia macrophylla*. Epiphytes are abundant. This forest is known locally as "akalche" or "tintal".
Faunistic comments	It appears that this is the preferential habitat for the rare and only recently discovered Gray Brocket Deer *Mazama pandora*.
References	Zimmerman & Olmsted 1992, Olmsted & Duran 1986, Brokaw & Mallory 1992, Wright et al. 1959: 23, Iremonger and Brokaw 1995: II.1.1.2.1. Picture: Orange Walk District. J. Meerman

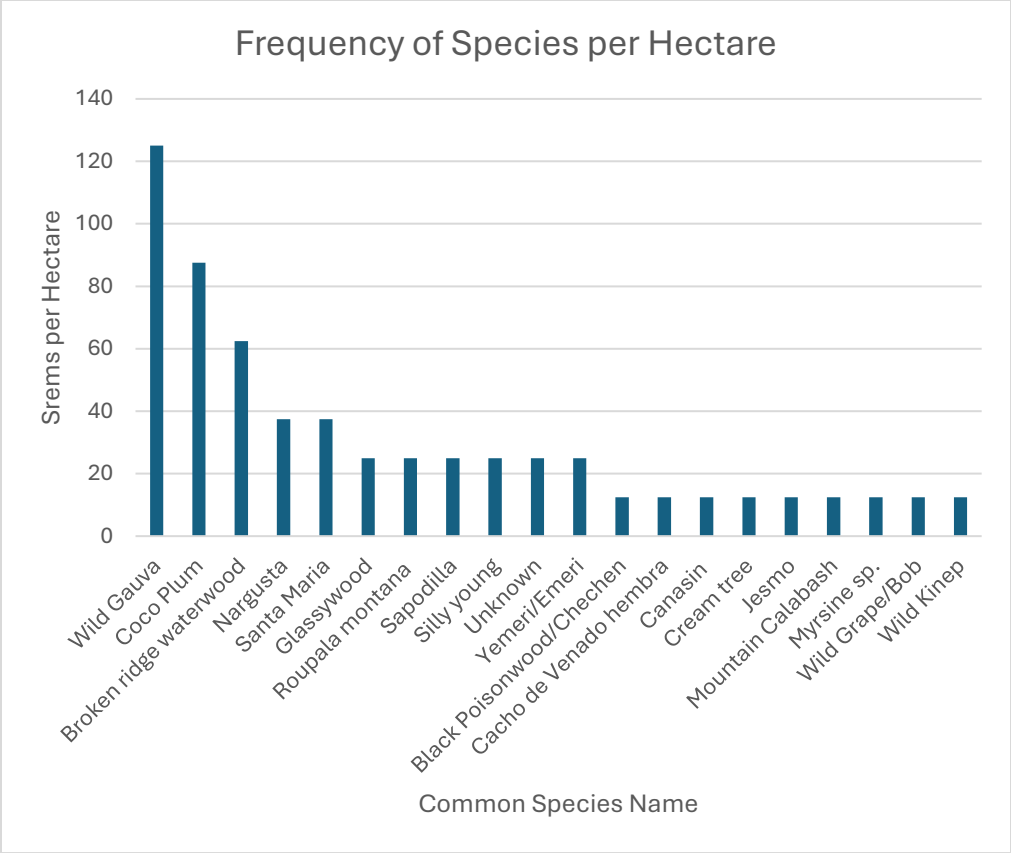


Figure 34: Frequency of species measured in broad-leaved lowland shrubland. Leguminous variant.

In Figure 34 above, the three most commonly found species that were measured are Wild Guava,(*Eugenia sp*.), Coco Plum (*Chrysobalanus icaco*), and Broken Ridge Waterwood (*Ilex guianensis*). All species measured were small diameter pole size trees. Table 37 provides a list of the understory species identified.

Table 37: List of understory species identified in the ecosystem.

Common Name	Scientific Name
Beak sedge	*Rhyncospora sp.*
Blossom Berry	*Hirtella racemosa*
Cacho de Venado hembra	*Mouriri exilis*
Cissus sp.	*Cissus sp.*
Cutgrass	*Scleria latifolia*
Morning Glory	*Odonellia hirtiflora*
Palmetto	*Acceloraphe wrightii*
Pigeon Plum	*Licania hypoleuca*
Platanillo	*Lantana sp.*

Riverside Kaway	*Cordia collococca*
Selaginella sp.	*Selaginella sp.*
Sensitive Bush	*Mimosa pigra*
Silver palm	*Thrinax radiata*
Wild Coffee	*Palicourea sp.*
Wild Guava	*Eugenia sp.*
Wild Jicama	*Pachyrhizus ferruginous*
Wild Kinep	*Matayba oppositifolia*
Yemeri	*Vochysia guatemalensis*

4.1.3.7 The Tropical evergreen seasonal broadleaf lowland swamp forest, Low variant

This ecosystem described below (Table 38) is found on the southern section of the SLCCL property and covers about 211 acres (85.6 has.). This Tropical evergreen seasonal swamp forest of short trees will remain as part of the conservation land within the SLCCL property.

Table 38: Tropical evergreen seasonal broadleaf lowland swamp forest, Low variant.

Legend Code	**43**
UNESCO Classification code	**I.A.2.g.(1).(a).L** IA2g(1)(a)-Sh
Name	**Tropical evergreen seasonal broadleaf lowland swamp forest: Low variant.**
Altitude	< 100 m.
Geology and soil	Generally, over calcareous rock. Some hog-wallow micro-relief exists as a result of repeated wetting and drying of the soil.
Water regime	Ill drained, often waterlogged for part of the year.
Rainfall	Average rainfall less than 2000 mm per year with a pronounced dry season from February through May.
Fire exposure	Limited to areas with slash and burn cultivation.
Description	Swampy stands of low, thin stemmed trees and shrubs without emergents. Usually associated with 1A2g(1)(a)T and closely related to IIIA1bL.There is a distinctive deciduous element.

Frequent plant species	Frequently encountered trees include *Acacia* sp., *Acoelorraphe wrightii (usually occurring in dense clumps), Bucida buceras, Calliandra* sp., *Calyptranthes* sp., *Cameraria latifolia, Chrysobalanus icaco, Clidemia* sp., *Crescentia cujete, Erythroxylum guatemalense, Haematoxylon campechianum, Hampea trilobata, Helicteres guazumifolia, Hirtella racemosa, Hymenocalis littoralis, Licania hypoleuca, Miconia* spp., *Mimosa hemendieta, Mouriri exilis, Rinorea* sp., *Xylopia frutescens* and *Zygia* sp.
Faunistic comments	
References	Meerman 1999c, Wright et al. 1959: 15, 23; Iremonger and Brokaw 1995: I.1.1.1.1.2. Picture: Old Northern Highway. J. Meerman

The broad ecosystem class described as lowland savanna remains fairly intact within the SLCCL property. Removal of this vegetation cover has been minimal and limited to accommodate building infrastructure rather than agricultural cultivation.

4.1.3.8 Low Land Savanna

Approximately 99% of the lowland savanna (Table 39) within the property is designated as conservation land by the land use plan. Two subdivisions are found within the lowland savanna as described below. They are differentiated on the basis of the density of the pine overstorey and the shrub layer. These ecosystems are important habitats for providing connectivity with the adjoining Runaway Creek Forest Preserve to the east of SLCCL and the Monkey Bay National Park to the west of SLCCL.

Table 39: Short-grass savanna with scattered trees and/or shrubs & Short-grass savanna with dense trees and/or shrubs.

Legend Code	**62**
UNESCO Classification code	**V.A.2.a.(1).(2).**
Name	**Short-grass savanna with scattered trees and/or shrubs** **Short-grass savanna with dense trees and/or shrubs**
Altitude	< 50 m.
Geology and soil	The soils all have in common that they have a pale coloured, course textured topsoil sharply overlying a compact, brightly red and white mottled finer textured subsoil. The soils are all acid and very deficient in nutrients (King et al. 1992).
Water regime	This and related forest types are often waterlogged during the rainy season but show drought stress during the dry season, especially in the understory.
Rainfall	Average rainfall generally less than 2500 mm per year with a pronounced dry season from February through May.
Fire exposure	With increased fire regime this forest type quickly degenerates to open short- grass savanna.
Description	This ecosystem is transitional from Short-grass savannas VA2b(2) to Tropical evergreen seasonal needle-leaf lowland dense forest IA2a(2)(b).
Frequent plant species	P*inus caribaea* is dominating but rather sparse in those savannas with scattered trees and shrubs. Other common trees and shrubs are *Acoelorrhaphe wrightii, Byrsonima crassifolia, Chrysobalanus icaco, Hirtella racemosa, Quercus oleoides* and *Xylopia frutescens.* Generally, there is a graminoid herbaceous layer dominated by sedges but with other herbs such as *Cassytha filiformis, Passiflora urbaniana, Turnera odorata* and sometimes *Gynerium sagittatum.* Some low shrubs such as *Clidemia* sp. and *Curatela americana* complete the understory.
Faunistic comments	This ecosystem appears to be an important breeding habitat for the Yellow-headed Parrot *Amazona oratrix.*
References	Meerman 1999c, Wright et al. 1959: 17, Iremonger and Brokaw 1995: I.2.2.7.; Cabrera and Sanchez, 1994. Picture: Southern Highway. Stann Creek District. J. Meerman

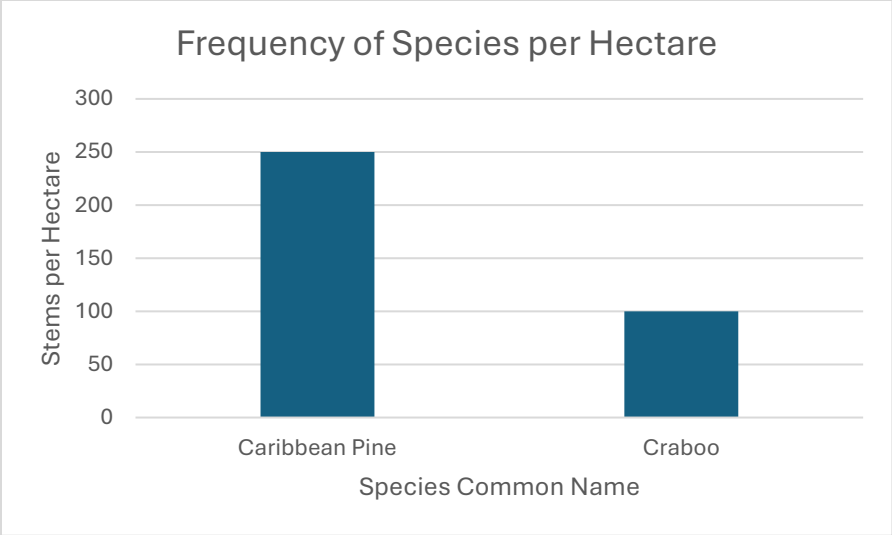


Figure 35: Frequency of species measured in short grass savanna with scattered trees or shrubs.

Figure 35 above provides the frequency of the species measure in short grass savanna with scattered trees and shrubs (see Figures 36 and 37).

Photo credit: Luis Peña
Transect through an area dominated by Pine (*Pinus caribaea*), Palmetto (*Acceloraphe wrightii*, Melastomes (*Miconia spp.*), and Wire grass (*Bulbolstylis paradoxa).*

Figure 36: Pine (Pinus caribaea).

Photo credit: Luis Peña
Recently burnt area dominated by Pine (*Pinus caribaea*), Craboo (*Byrsonima crassifolia*) , Oak (*Quercus spp.*), and Wire grass (*Bulbolstylis paradoxa)*.

Figure 37: Recently burnt pine.

Table 40 provides a list of the understory species found in this ecosystem.

Table 40: List of understory species identified in the ecosystem.

Common Name	Scientific Name
Blossom Berry	Hirtella racemosa
Craboo	Byrsonima crassifolia
Cutgrass	Scleria latifolia
Negrito	Simaruba glauca
Palmetto	Acceloraphe wrightii
Pine Ridge Sirin	Miconia albicans
Sandpaper Tree	Curatella americana
Sandpaper Vine	Davilla Kunthii
Sirin	Miconia cilliata
Wild Coffee	Amaioua glomerulata
Wire Grass	Bulbolstylis paradoxa

4.1.3.9 Eleocharis marsh ecosystem

The Eleocharis marsh ecosystem (Table 41) is found in two places at the south-eastern edge of the property. The two are tiny corners, barely visible on the map of a much larger area that extends outside the SLCCL property. This ecosystem is within the conservation land area of the SLCCL property.

Table 41: Eleocharis marsh

Legend Code	**65**
UNESCO Classification code	**V.D.1.a.(1)**
Name	***Eleocharis* marsh**
Altitude	< 50 m.
Geology and soil	On alluvial deposits. Soils often peaty over clay.
Water regime	Mostly inundated, frequently with water of a somewhat higher salinity
Rainfall	Variable
Fire exposure	In savanna areas potentially exposed to fires.
Description	These almost monospecific marshes may be found in waterlogged plains, fringed with shrubs. The height of the herb layer is about 50 cm. Common in small patches in short-grass savannas but mostly too small to be mapped. A good example of this ecosystem can be found along the Hopkins road in the Stann Creek district.

Frequent plant species	The dominant species is an *Eleocharis* sp. Additional plant species commonly found here include *Blechnum serrulatum, Centrosema* sp., *Crinum erubescens, Hyptis* sp., *Ludwigia* spp., *Mimosa pigra, Sagittaria lancifolia* and *Thalia geniculata.*
Faunistic comments	
References	Meerman 1999a, Meerman and Boomsma 1995a, Rejmánková et al. 1996, Iremonger & Brokaw III.1.1.2.1. Picture: Hopkins, Stann Creek District. J. Meerman

4.1.4 Summary of Flora Surveys

It should be noted that no rare and endangered species were found in the SLCCL property. The ecosystems identified in the property are found adequately represented several times in the adjoining land areas including protected areas such as Monkey Bay Wildlife Sanctuary, Monkey Bay National Park, and Runaway Creek Preserve. While these ecosystems outside the property are also subject to frequent wildfires and extreme climate change driven weather conditions, they may be better protected from anthropogenic impacts such as illegal logging, and hunting. There was a marked absence of timber trees of commercial size observed in the property or recorded in the transects. Salvage logging in the areas yet to be cleared would be minimal at most and limited to those few trees approaching commercial size.

4.2 Fauna/Wildlife

4.2.1 Methodology

Floristic biodiversity is a good proxy for overall ecosystem biodiversity. Therefore, most wildlife surveys were opportunistic within the vegetation type transects used in the field vegetation surveys, although opportunistic recordings were also utilized throughout the SLCCL property whenever possible. Direct field observations are complemented with data from previous studies either within the SLCCL property or in similar ecosystems particularly in the protected areas adjoining the property. The increasing popularity of citizen science platforms such as iNaturalist and eBird have also contributed to the faunal database.

Birds

Birds were assessed using spot counts and opportunistic recording while conducting the floral survey on the transects as well as any other walks through the study area. Both visual and vocal

characteristics were used for identification. The bird survey was linked to the ecosystem types. This method of inventory gives a good indication of the biodiversity in the transects.

Mammals

Different methodologies are required for a thorough mammal survey. Camera "traps" or trail cameras are increasingly used for larger mammals and live traps can be set for smaller mammals. Nearly every species requires a separate approach. It often takes years to obtain meaningful data as the overall success rate of these methodologies can be very low. Consequently, for the purposes of this study, mammals were assessed by direct opportunistic observation along the study transects, interviews with persons known to frequent or work in the area and complemented by data gathered either from previous studies or by citizen science platforms such as iNaturalist.

4.2.2 Birds Recorded

A total of 53 bird species were recorded. For comparison the adjacent Monkey Bay Wildlife Sanctuary has recorded 333 species (MBWS Management Plan , 2022-2027) but it should be pointed out that these records span several years throughout the 12 months of the year whilst recordings in SLCCL occurred over a few days during the dry season months.[1] The four most recorded species in the SLCCL survey were Brown Jay (*Psilorhinus morio) (Figure 38),* Smokey-brown Woodpecker (*Dryobates fumigatus),* Spot-breasted Wren (*Pheugopedius maculipectus), and* Yellow-green Vireo (*Vireo flavoviridis).*

No bird recorded is listed as rare or endangered. See bird list in Appendix VII.

4.2.3 Butterflies

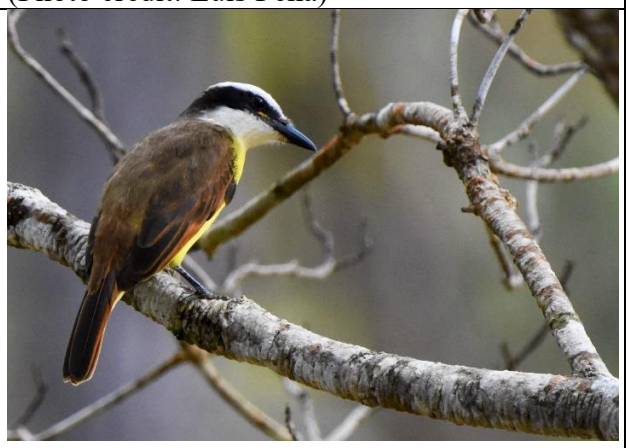
No butterflies were recorded during the survey in SLCCL. However, Appendix VIII provides a list of these species obtained from iNaturalist (Meerman, 2022) in the adjoining Monkey Bay Wildlife Sanctuary in similar ecosystems and form the Biodiversity and Environmental Resource Database for Belize (BERDS).

[1] Piaskowski, V.D., et al. recorded 196 bird species through mist netting in a 39 day period from 2000 to 2003 on the northern edge of the Runaway Creek Nature Reserve sampling mostly riparian forest ecosystems. (Piaskowski et al. 2006. Birds of the Sibun Riverine Forest, Belize. Birds without Borders.)

Roadside Hawk
(Photo credit: Luis Peña)

Yellow-tailed Oriole
(Photo credit: Luis Peña)

Brown Jay
(Photo credit: Luis Peña)



Great Kiskadee
(Photo credit: Luis Peña)

Figure 38: Recorded Bird Sightings.

4.2.4 Mammals

Very few mammalian species were directly observed or otherwise detected within the area as can be seen from Table 42.

Table 42: List of Mammalian species observed in SLCCL.

Common Name	**Scientific Name**	**Observation**
White- Tailed Deer	*Odocoileus virginianus*	Scat observed
Gray Fox	*Urocyon cinereoargenteus*	Directly observed
Baird's Tapir	*Tapirus bairdii*	Tracks/scat observed
Yucatan squirrel	*Sciurus yucatanensis*	Directly observed

SLCCL has the usual species composition of mammals that one can expect to find in the lowland broadleaf forest and lowland savannas. However, a key species that is absent from SLCCL and the surrounding areas to the south of the George Price Highway is the White-lipped Peccary (*Tayassu pecari*)because of increasing loss of habitat due to land use change and rapid development. Although not recorded in SLCCL, the Jaguar (*Panthera onca*) has been recorded numerous times in adjoining properties, an indication of a healthy or at least adequate prey population. Pumas (Puma concolor) have not been recorded in the area but the possibility exists for their movement through the area. Increasing development not only in SLCCL but other properties as well, is reducing habitat for these large cat. Therefore, the provision of conservation lands within the SLCCL property are critical to maintaining some habitat for these large predator species. White nosed Coati (*Nasua narica*) and the Central American Agouti (*Dasyprocta punctata*) are perhaps the most common mammals to be found on the property. Appendix IX provides a list of mammals that are most likely present or utilize habitat within survey.

4.2.6 Amphibians and Reptiles

The amphibians in SLCCL include the Common Mexican Tree Frog and reptiles found are typical lowland species which includes geckos, anoles, iguanas, turtles, and snakes. Morelet's Crocodile (*Crocodylus moreletii*) would of course be found in the Sibun River. The Hicatee turtle (*Dermatemys mawii*) occurring in the Sibun river is a critically endangered species. A list of amphibians and reptiles sourced from the BERDS and iNaturalist is provided in Appendix X.

4.2.7 Fish

No fish data was directly recorded in SLCCL. However, BERDS contains data from elsewhere along the Sibun River. Data from a stretch of the Sibun River 30 kms. upstream and 30 kms downstream from Monkey Bay Wildlife Sanctuary provides a list of 37 species (Meerman, 2022) that would be valid for SLCCL. Appendix XI provides the fish species list.

4.2.8 Others

Appendix XII provides the list of the insects, Arachnida and Mollusca species found on the project.

4.2.9 Conclusion

Even though historic and current agricultural development within SLCCL will have removed natural vegetation cover on about 75% of the land, the retention of 25% as conservation land plus the riparian buffers will continue to provide an important habitat for most of the species of wildlife

that are found within the SLCCL property. However, perhaps even more importantly, is the connectivity function provided between Runaway Creek Nature Reserve and Monkey Bay Wildlife Sanctuary. Both properties are part of the Maya Forest Corridor. The protection of this conservation area within the property from fire, illegal hunting, and illegal logging would greatly assist to improve habitat function.

4.3 Potential Impacts to Flora And Fauna

4.3.1 Introduction

The potential impacts to flora and fauna are described in terms of their significance at the local, regional, or national level as appropriate.

Potential impacts are described prior to enacting management measures; thereafter, control and management strategies are then described for each impact. These strategies set the basis for responsible environmental management and are designed to be technically and economically appropriate given the context of the Project's setting.

The environmental and social objectives for all phases of the Project are based upon the potential environmental impacts and residual risks identified for the Project. Each environmental objective is accompanied by measurable criteria that can be used to assess progress towards compliance with the objectives. Where possible, measurement criteria are based upon relevant standards and guidelines to adequately provide measurable assessment criteria.

4.3.2 Impact to Biodiversity in relation to Existing Land Clearing

A significant percentage of the land, which totals approximately two thousand eight hundred acres has been altered and impacted directly as a result of vegetation removal for land conversion to agriculture productive lands. This land conversion occurred several decades ago since the lands form part of an existing agro - productive farming system. Perhaps the most visible impact is the absence of the previously dense forests, which represented part of a previously contiguous ecosystem. Lands have been clear cut for the planting of various crops such as corn, sorghum, beans, and other crops and fruits.

The land clearing has resulted in habitat loss to biodiversity, in terms of loss to both flora and fauna, and the alteration of the aesthetics of the landscape, as well as a loss of the carbon

sequestration capacity of the previously lush forest. However, the carbon sequestration capacity is relatively low in comparison with the national level. The loss of sequestered carbon, however, is somewhat compensated by the planting of crops (including fruit trees), although the carbon sequestration potential of crops is far less than that of a naturally forested area.

Another direct impact has been the fragmentation of the ecosystem. When large parcels of land are devoid of vegetation, naturally existing habitats that form part of wildlife corridors are altered, and wildlife lose part of their liveable ecosystem and also become vulnerable to predation by man, as a consequence of hunting practices.

Death of wildlife through hunting techniques are also a consequence of the land conversion to agro - productive systems. A well- known hunting technique used in rural Belize is to wait for planted crops to start shoots that attract deer and other game, which then attract hunters. The agouti paca (gibnut) is also hunted using similar methods.

Fragmentation also results in the creation of habitat for certain birds that use dry trees to create nests. Parrots of various species often use these nests, and this in turn attracts illegal hunters that capture these wild parrots for illegal trade. However, this can also be beneficial within a privately held parcel of land because illegal trade can be prohibited, which is the case in the development in question. Despite these alterations, the planting of crops does attract birds who feed from planted crops and related produce such as corn, and seeds dispersed during the planting process.

The impacts are summarized as follows:

- **Impacts to Threatened Species**
  Vegetation clearing may reduce the abundance of threatened flora species with impacts to populations of threatened species at the local level.
- **Reduced Species Abundance**
  Clearing vegetation will be necessary during implementation of the Project. The clearing process will remove plants from the broader species populations in and around the area which may have adverse effects on plant species abundance on a local level.
- **Introduction of New Weed Species and Weed Infestations**

Vegetation clearing, land disturbance and vehicle movement has the potential to increase weed populations or create conditions favourable for the establishment of weed species within the Project area.

- **Reduced Fauna Population**

  While the species count resulted in low estimates of species of wildlife, this may be due to the seasonal dry season that was compounded with problems such as forest fires and smoke from these fires, around the property. The fragmentation of the ecosystem is also a factor in the reduction of wildlife. There was evidence that a few species of conservation importance had been present in the area in the immediate past. This was determined by observation of the scat from deer species and from the tapir. There is potential for species abundance to be reduced as a result of:

  - Native fauna habitat destruction during clearance activities.
  - Noise and traffic movement disturbing resident populations of native fauna (birds) within the Project area.

- **Increased abundance of introduced species.**

  There will be no species introduced as a result of this project. Opportunistic pioneers who may find an adequate habitat may multiply rapidly. However, this would be short lived as these habitats would be regularly destroyed during harvesting. The residual impact is low.

- **Loss of aesthetic value and loss of habitat.**

  The value of loss of visual aesthetics of the site within the local context is not considered significant. Table 43 below provides an impact matrix associated with the activities of the project.

4.3.3 Proposed Mitigation Measures

The control measures and strategies to manage the project-related risks to fauna are outlined below.

- Dust Suppression: Limit the time for land preparation to reduce time of exposure.
- In terms of the Introduction of new weed species and increased weed density should be dealt with through the active surveillance and their suppression.
- Road works will be kept to a minimum in size and drains will be outfitted with sediment traps prior to their discharge into the Sibun River.
- Practice Crop Rotation to reduce pest infestations and practice Integrated Pest Management.

- Use only pesticides registered by the Pesticide Control Board of Belize and rotate the use of pesticides to avoid pests from building resistance to pesticides.
- Endeavour to curtail the aerial spraying of crop fields by duster planes and use preferably tractor mounted sprayers and fertilizer applicators. Where possible use drone mounted sprayers.
- The setting aside of a 150 feet wide buffer along the Sibun River should reduce the impact of agricultural runoff and impacts of fugitive windblown pesticides during its application. This should also assist in providing a corridor for wildlife to transit through the property and provide connectivity with adjacent lands set aside for conservation.
- The implementation of appropriate solid waste disposal and management will be conducted in accordance with a solid waste management plan to prevent risk to wildlife.
- Prevent hunting and poaching withing the property.

The project will retain the existing 150 feet (45.72 meters) wide riparian forest along the Sibun River. In areas that do not have this width of vegetation strip, it is recommended that vegetation is allowed to grow back and local species may be planted under guidance from foresters and other experts in areas where the reserve had been previously cleared.

Table 43: Flora and Fauna Impact Matrix.

Affected Medium	**Activity & Impact**	**Type of Impact & Direction (+ or -)**	**Magnitude**	**Duration**	**Scope**	**Significance**	**Medium & Reversibility**
Biological /Terrestrial and aquatic	Flora and Fauna/ Land clearing/land preparation/ Installation of drains	- Neg. - Direct	High	Short	Local	Medium	Cumulative Reversible
	Movement of heavy equipment	- Neg. - Direct	Medium	Short	Local	Medium	Reversible
Water Quality/Water resources & Water bodies	Fertilizer input (risk of nitrification)	- Neg. - Direct	Medium to long term	Medium	Local	Medium	Reversible
	Risk from hazardous waste or pesticide use	- Neg. - Dir	Long term	Long term	local	high	Reversible/ preventable
	Risk for sewage contamination	- Neg. - Direct	low	Long term	Regional	low	Can be irreversible
		-					
Hydrological features	Minor risk to River basin	- Neg. - Direct & Indirect	Low	Medium	Local	Low	Reversible
Topographical characteristics	Land use change with drains and soil tilling	- Neg. - Direct	Medium	Long term	Local	Medium	Reversible
Land Use pattern (land use conflicts)	Lands are designated for agro-productive system/ Reserve areas accessible to NGO	+ Pos. - Direct	Medium	Long term	Local	High	Reversible

CHAPTER 5 WATER RESOURCES MANAGEMENT

5.1 Water Sources

Available freshwater sources for drinking, domestic needs and watering of plant and crops are the following:

1) Bottled water
2) Groundwater
3) Rainfall water harvesting
4) Pond water
5) River water

At present, the Belize Water Services Limited (BWS) water distribution network does not extend to the project site. Nearby La Democracia Village and Mahogany Heights obtain their water through Rudimentary Water Systems (RWS), while commercial businesses in the area utilize bottled water for drinking, and rainwater and treated pond water for domestic purposes. The project is an agriculturally based development which does not entail any homesteads and the limited domestic water use is limited to drinking water and water for sanitary uses by farm workers. Abstracting water from the Sibun River for limited domestic use is not an option at present because of the distance.

5.2 Water Availability

5.2.1 Bottled water

This is a reliable source for business enterprise and home use, and is readily available from dealers in Belmopan, Roaring Creek, and village grocery stores in the area.

5.2.2 Groundwater

No definite groundwater capacity data is available for the SLCCL farming site. However, the King (1992), Land System and Drainage Density review (Section 2.3.4) indicates that groundwater availability in the area is generally high (King et al., 1992). According to the US Corps of Engineers survey (Buckalew, 1998), the Campur groundwater province in the northern and northeastern foothills of the Maya Mountains reported yields in the order of 57 to 1,125 L/min or 15.06 to 297.19 gpm. Wells drilled in the Green Tropics agriculture development and another at

the Belize Sustainable Agriculture Ltd. around Cotton Tree Village produced artesian water, with the latter having a projected flow rate of over 2,000 gpm from a 120 ft production well (Tunich Nah, 2014). In Armenia Village, ground water is the main water source for the village since May 2018. A Rudimentary Water System supplies water from a 190 ft-deep well to an elevated tank and gravity feed it through the village water supply network. This well produces about 250 gpm. The production capacity of La Democracia well for its rudimentary water system (RWS) is 200 gpm. There is presently no groundwater production well on the SLCCL farming development site. The proprietor of the development indicated that extracting groundwater is not an option, and they will do with the usual rainfed farming practice.

5.2.3 Rainfall harvesting

Rainwater harvesting is a viable water supply option for domestic use after in situ treatment with chlorine or boiling. Currently, there is no data on roof catchment areas to estimate the volume of rainwater harvesting. Additionally, storage and transmission will have to be designed in order to assess the feasibility of this option. Table 44 provides an estimate of potential supply of rainwater from catchment area. This estimate is given by:

Rainwater Harvest = (Mean yearly or monthly rainfall) x (total roof area) x (catchment (roof) coefficient)

Table 44: Water harvesting catchment type.

Type of Catchment	Roughness Coefficient (n)
Corrugated roof (zinc, other metal)	0.7 - 0.9
Bare soil	0.2 - 0.75
Untreated ground and landscape, slope < 10% gradient	0.0 – 0.3

Source: www.watershedmg.org.

The present structures can be outfitted with gutters to collect rainwater and to store this in Rotoplast tanks for the limited domestic use by the farm workers.

5.2.4 River Water from the Sibun

A future water source for the proposed farming development is direct abstraction from the Sibun River or establishing a well gallery on the bank of the Sibun River and transmitting the water to the fields. The water will be filtered naturally, treated, and pumped to elevated tanks, from where it can be gravity fed through an adequate and maintained potable water supply system to designated sites. Table 45 provides an estimate of available water resources in the project area.

Table 45: Estimate of available water in and around the SLCCL farming operation.

Source	Capacity per Annum (m^3)	Capacity per Annum (US gallons)	Remarks
Unit Rainwater (Roof 24 ft x 30 ft) Mean Bmp Rainfall 2009 Bmp monthly rainfall (example)	**94.66**	25,007.2 (21,486.0)*	Variable. Depends on roof catchment and capacity of holding tanks. Water harvest for roof area of 24 ft x 30 ft on Farm site using mean monthly rainfall for Belmopan
Groundwater (Wells/ponds-springs)	**663,668.41**	**Well #1**, 120 gpm = 63.07 x 10^6 US gallons per year (g/yr) 120 g/m x60m/hr x 24hr/d x365 d/yr. **Ponds #1 & #2**:** 200 gpm = 105.12 x 10^6 g/yr **Total** = 168.19 x 10^6g/yr	Variable: 15 – 297 gpm for shallow wells in area. Cayo Grains Ltd., Ontario Village has a new well yielding 120 gpm. Artesian well at BSAL, Cotton Tree yield approximately 2000 gpm from one artesian well.
Sibun River at Sleeping Giant Resort	**1,422,273,600.0**	45.1 m^3/s = 1,422,273,600.0 m^3/yr	Annual Average 45 m^3/s (Source: BET 2018)
Total available	**1,422,937,363.0**	**3.7590022091 x 10^{11} USG** 1m^3 = 264.172 USG	This total includes the estimated contribution from the Sibun River

Table 46 shows an estimate of available water for the SLCCL farming operations. Included in the table is an estimate of rainwater harvesting on the farm area using the existing roof catchment area and a represented, actual annual rainfall value from a Belmopan Met Station, which is considered close to the project site and figures can be extrapolated. The year chosen from the annual rainfall record is 2009 because it was a relatively dry year for central Belize and in Belmopan rainfall record. The 2009 rainfall data (*) was used as an example for the estimated rainfall harvest potential and the rainfall harvest estimate was not used in the total water source estimate available for farming operations and with two ponds (**) providing water for six months only.

The conservative, total fresh water available in the general area of the SLCCL farming development is approximately 1.423 billion cubic meters per annum or **3.7590022091 x 10^{11} US** gallons per annum. As noted, this volume includes the estimated contribution from the main Sibun River, having a mean flow of 45.1 m^3/s as shown in Table 40 above.

5.3 Total Water Demands

5.2.1 Domestic Use

"*Domestic use" in relation to the abstraction of water means the use of such water for – drinking, washing, cooking and sanitary purposes in connection with a residence; or farming, gardening, the watering of livestock or pen-keeping in connection with a household where the entire area of land does not exceed 5 acres*" (PART I, NIWRA, 2010)

On a daily basis domestic water supply for the proposed SLCCL farming development will be minimal. Water use will be mostly for farm workers and machine operators, and for the caretakers' families residing on the site. Consequently, water will not be a limiting factor.

Table 46 shows an estimate of the water demands at the project site at full operational capacity during planting and harvesting time.

Table 46: Maximum freshwater requirement for a 1-acre parcel.

Need		Persons	Period	Gal. per person per day	Seasonal Total (gallons)	Total per annum (m^3)
Human Use	Domestic / security/Field	50 – planting and harvest time	180 days (six months)	40	360,000	1,362.75*
	No onsite subdivision or residential zone					
Total					**360,000**	**1,362.75**

*One cubic meter of water is equivalent to approximately 264.172 gallons

The estimated, total freshwater needs per annum for domestic, field, and human use is 360,000 U.S. gallons per annum or 1,362.75 cubic meters. It is assumed that daily water consumption per machine operators and farm field workers per day is 40 gallons.

5.4 Impacts and Mitigation

The impacts on water resources have been evaluated in connection with the main activities that will be conducted in the Spanish Lookout Community Corporation farming development. Some of these activities are avoidable and reversible. The majority of the land has already been converted

to crop land, and clearing of the remaining broadleaf forested area or *wahmil* will be minimal. Impacts of farming operations on the environment will be the introduction of chemical fertilizers, agrochemicals and sedimentation of ploughland in the floodplain. Mitigation measures to reduce the impacts of these activities are proposed for consideration and implementation by the proprietors.

Table 47 shows a quantitative estimate of activities related to the SLCCL farming development on local water resources.

Table 47: Impacts on water resources by the SLCCL Farming site.

Environmental Effects	**Water Quality**					**Hydrology of Area-Rivers and Streams**							**Total**
Developmental Activities	Oil/ hydrocarbons	Siltation-TSS	Bact. contamination	Dissolved Oxygen	Nitrate/Phosphates sulphates	Siltation/increased sedimentation	Flow regime	Livelihood	Drinking water	Bank Erosion	Riparian vegetation	Ground Water	
Land clearing, tillage, soil removal, and construction	-3	-2	-2	-2	0	-3	-3	0	-2	-2	-3	-2	**-24**
Agrochemical application and aerial chemical dusting	0	0	0	-1	-3	0	0	-3	-2	0	-1	-1	**-11**
Access road construction and maintenance	-3	-2	-2	-2	0	-2	-2	+1	-1	-1	-1	0	**-15**
Drainage	-1	-3	-1	-2	-1	-3	-3	-1	-1	-1	-1	+1	**-16**
Water abstraction from Sibun River	0	-2	-1	-2	-1	-1	-3	0	-1	-2	-1	0	**-14**
Water abstraction from ponds, springs, wells	0	-2	-1	-2	-1	-2	-3	0	-1	-1	-1	0	**-14**
Degrading riparian forest buffer and/or floodplain	-2	-3	-3	-2	-2	-3	-2	-2	-2	-3	-3	-2	**-29**
Amenities water use	-1	-2	-1	-2	-2	-3	-2	-1	-2	-2	-1	-2	**-21**
Well drilling	-3	-1	-2	-1	-2	0	0	+3	2	0	2	-1	**-3**
Mining karst hills	-3	-2	-1	0	-2	-2	0	+3	-1	0	-1	-2	**-11**
Degree of impacts: -3 High negative; -2 Medium negative; -1 Low negative; 0 none; 1 Low positive; 2 Medium positive; 3 High positive.													

As can be observed, the largest impact may arise from land clearing and disruption of the natural drainage in the floodplain. Table 48 provides a summary of the proposed mitigation measures that can be implemented to reduce some of the impacts. These should be considered when drafting an Environmental Compliance Plan.

Table 48: Proposed mitigation measures to reduce the impacts on water resources at SLCCL.

Activity	Impact	Type	Magnitude	Scope	Duration	Mitigation
Land clearing (secondary & primary forests) and soil removal / mining	Removal of habitat and food for native fauna. Change in local hydrology and microclimate. Erosion and increased sedimentation	Adverse	Medium	Direct	Long term	Reduce land clearing acreage. Keep at least 20 % of land in reserve to ameliorate impact on hydrology. And wildlife habitat. Do minimal tillage
Agrochemical application in the general farming blocks	Leaching into soil and groundwater. Runoff into surface water bodies. Dispersed into nearby farms	Adverse	Low to medium	Direct	Long term	Reduce aerial application as much as possible. Plan terrestrial application to coincide with rain/dry events. Construct berms or holding ponds.
Access road construction and maintenance	Increased erosion; damming and soil disturbance	Adverse	Low	Direct	Short term	Minimize earth/soil disturbance as much as possible. Ensure zero oil leakage in fields. Practice sustainable mining.
Drainage	Change hydrology of wet land; disturb/destroy aquatic habitat; reduce flooding and improve land use	Adverse Beneficial	Medium to high	Direct	Long term	Stabilize drainage banks and reduce effects on natural wetlands as much as possible. Construct settling ponds. Direct drainage towards river and streams. Schedule drainage maintenance.
Water Abstraction from Sibun River, ponds, streams and/or groundwater	Reduction in water quantity to users downstream	Adverse	Medium	Direct	Long term	Keep within limits of abstraction license. Have a water conservation plan
	Change water quality of surrounding surface water; change water table; possible contamination	Adverse	Medium	Direct	Long term	Keep within limits of abstraction license. Have a water conservation plan. Avoid contamination of groundwater sources.
Degrading Riparian Forest Buffer (RFB) and/or floodplain	Increase erosion and sedimentation. Loss of habitat wildlife. Shade and food source for aquatic organisms	Adverse	Medium to High	Direct	Long term	Respect a 100 ft or more riparian forest buffer (RFB) strip along all waterways. Restrict deforesting or degrading RFB
Water use amenities	Decrease water availability. Affect surface and groundwater and may increase leaching and salinization	Adverse	Medium	Direct	Short term (seasonal)	Use an efficient system that will conserve water and reduce loss by leakage and evaporation.

CHAPTER 6 GEOLOGY AND SOILS

6.1 Soils of The Project Area

Based on the British Honduras Provisional Soil Map of Belize developed by the Directorate of Overseas Surveys, 1958, and on the revised classification of soils by Baille et al, 1993, a regional appreciation for the soil types throughout the development can be had. Detailed onsite inspections and test pits were used to provide site specific soil profiles and characteristics.

Regionally the development lies in an area that exhibits two main soil suites, mainly the Puletan and Tintal Suites (see Figure 39), which consists of primarily coastal deposits, alluvium and colluvium.

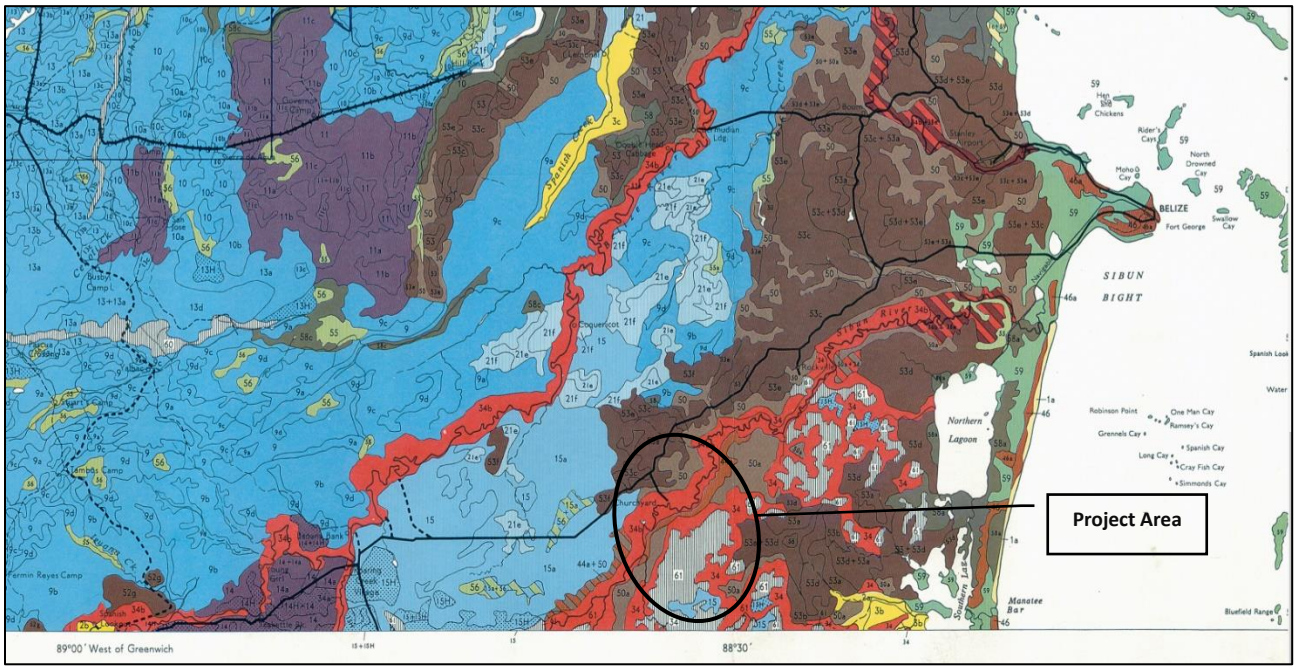


Figure 39: Provisional soil map of Belize showing the soil types in the project area.
British Honduras Provisional Soil Map, Directorate of Overseas Surveys, 1958.

6.1.1 Puletan Suite - Sub suites Boom, Bladen and Haciapina

The Puletan Suite corresponds to soil types 53 (a,c,e,f) which are categorized as Maure-Coastal Deposits, with soil type 50 categorized as Early Submature alluvium classified as Haciapina by Wright et all, 1959, and are classified as Puletan sands/coarse sands/sands and loams. The Puletan Suite soils are derived from the Tertiary to Pleistocene coastal alluvium. It is made up of pale coloured sands or loams over acid and impermeable brightly mottled “corn beef sandy clay”.

Boom Sub suite: This is distinguished as “dark sandy topsoil over light grey or pale-yellow sand, sometimes going bright yellow at base, abruptly over brightly mottled red and white compact “corned beef”; sandy clay or sandy clay loam”.

Bladen subsite: This is distinguished as “shallow, dark loamy topsoil over yellow, or pale brown loam, abruptly over bright and red mottled compact sandy clay “corned beef” subsoil”. This is the most common of the three sub suites.

Haciapina sub suite: This is distinguished as “shallow grey sandy surface over deep, pale wet sand. Abruptly over brightly mottled red and white sandy clay loam-sandy clay compact “corned beef”, found on lower slopes, fringing palmetto wet spots. This is the least common of the three subsites.

6.1.2 Tintal Suite – sub sites Chucum

The Tintal Suite corresponds to soil types 15a, which are categorized as Meadow Soils – calcareous groundwater by Wright et al., 1959 and classified as Chucum (all). These soils are not dependent on the parent material but are characterized by poorly drained grey mottled loams, clays and peats of swamps.

Chucum sub suite: these soils are described as gleys of seasonal wet depressions in undulating limestone terrain, dark clays with occasional sandy clay to more than 1m, wide cracking in dry season that swell to give a massive sicky plastic clay in the wet season, gypsum crystals are often present in the subsoil.

6.2 Soils Investigation

The objectives of the soil testing are to determine: 1. Soil permeability, 2. Soil Profile and 3. Potential risks and associated impacts’ activities such as agriculture, and associated activities:

1. **Soil permeability:** The moisture in the soil is a basic input to crop production, hence the need for the determination of the permeability in the development site. Permeability is an indication of the ability of the soil to store water. The more permeable the soil is, the greater the seepage.

2. **Soil profile:** The soil profile will assist in determining the of type soil that is found in the development and by extension its potential fertility Note: Determining soil fertility is best derived from random soil analysis, (See Chapter 7: Figures 46 and 47).
3. **Potential Risks and Associated Impacts:** These are the potential risks and associated impacts which may result on the soils of the project arising from activities such agriculture, and associated activities such as ploughing, etc.

6.2.1 Soil Investigation Methodology

Soil Permeability

The moisture in the soil is a basic input to crop production, hence the need for the determination of the permeability in the development site. Permeability is also an indication of the ability of the soil to store water and nutrients.

Soil permeability is a property of the soil to transmit water and is commonly measured in terms of the rate of flow of water through the soil in a given period of time and is usually expressed as a permeability rate in inches per minute or other similar units. The more permeable the soil, the greater the seepage. Soils are made up of layers and the quality of the soil varies from one layer to another. The soil permeability is affected by several factors which can sometimes be specifically localized. Some of these factors may be as a result of roots being removed with mechanized equipment, cracks and holes caused by mechanical clearing and ploughing action.

The permeability tests were conducted at points located within the areas proposed in the development map as designated for farming/agricultural purposes.

6.2.2 Soil Permeability Test (Percolation Test)

The field test for measuring permeability rates were conducted in the open test pits. Holes 10 inches in diameter and 12 inches in depth were dug. Water was poured into the hole to a level of about 8 inches. Water seeped down rather quickly and had to be refilled constantly as it disappeared. The constant refill was made to maintain the 8-inch level. The pores of the soil were eventually filled with water and the seepage slowed down. After the seepage became constant the measurements for permeability were taken. The measurements were taken at ten-minute intervals; these were started when the measurements became nearly the same or constant.

6.2.3 Soil Profile

The soil profile is a vertical section through the soil mass which would normally show how the soil is made up of layers of soil with different properties. The soil profile description includes soil colour, soil type, and other significant observations. Soil samples were chosen over a wide area of the development. The samples were obtained with the use of a post hole digger and from drain and road cuts. These were obtained at points located within the areas proposed in the development map as designated for farming/agricultural purposes (see Figure 40).

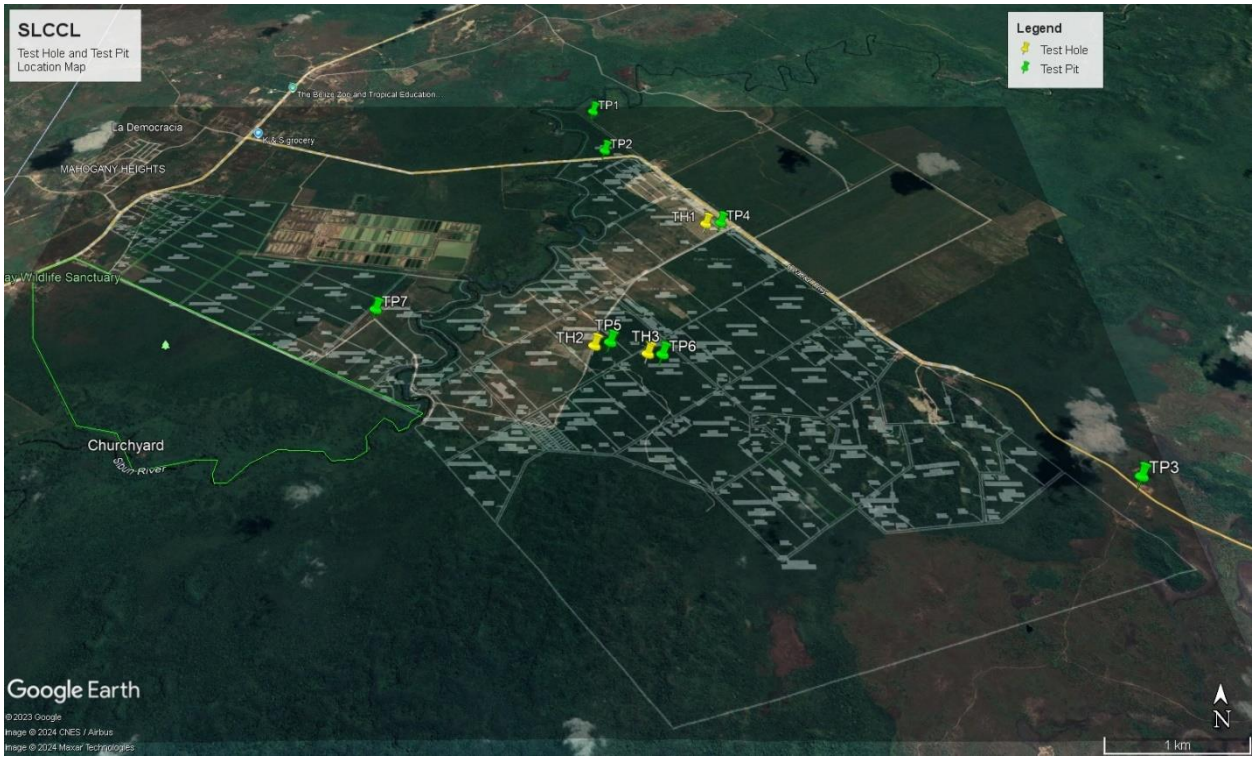


Figure 40: Test Hole (TH) and Test Pit (TP) Location Map.

6.2.4 Soil Percolation* Tests

* Soil Percolation are field tests for measuring soil permeability rates.

* Performed by: Alberto Rosado (Civil Engineer)

From the onsite testing shown in Figures 41 to 43, it was determined that the permeability of the soil at the development based on the permeability rates can be described as ranging from moderately rapid permeability rate to a rapid permeability rate (Solina 2003). Silt soils, with intermediate-sized particles allow water to move more freely than clay soils but less rapidly than sandy soils.

Test #1 – TH#1- Location: 0340066 m E, 1916152 m N. (Projections are UTM NAD 27 Central, Zone 16N)

- Test Date(s): 04/22/2024 Time: 2:00 pm
- The time interval between water level measurements was: 10 minutes.
- **TEST DATA**: The test holes were **PRE-SOAKED** for: 1.5 hours, or overnight.

The ground water table was not encountered. The soil permeability class for agriculture is rapid permeability rate.

Test Hole # 1- 0340066 m E, 1916152 m N. (Projections are UTM NAD 27 central, Zone 16N		
Hole Depth (Inches) – 12 inches		
Interval Number	**Elapsed Time (Mins)**	**Water Level/ Drop (inches)**
Start = 0 min		
1	10	1.5
2	20	1.5
3	30	1.25
4	40	1.25
5	50	1.00
6	60	1.25
7	70	0.75
8	80	0.25
9	90	0.25
Permeability rate(in/min) is: 1.25/10 = 0.125 in/min		

Figure 41: Percolation Rates for TH#1 and image of Test Hole #1.

Test #2 – TH#2- Location: 0338771 m E, 1914367 m N. (Projections are UTM NAD 27 Central, Zone 16N

- Test Date(s): 04/30/2024 Time: 2:30 P.M.
- The time interval between water level measurements was: 10 minutes.
- **TEST DATA**: The test holes were **PRE-SOAKED** for: 1.5 hours, or overnight.

The ground water table was not encountered.

The test was conducted on a field that was levelled only and not ploughed.

The soil permeability class for agriculture is moderately rapid permeability rate.

Test Hole # 2- 0338771 m E, 1914367 m N . (Projections are UTM NAD 27 Central, Zone 16N		
Hole Depth (Inches) – 12 inches		
Interval Number	**Elapsed Time (Mins)**	**Water Level/ Drop (inches)**
Start = 0 min		
1	10	0.50
2	20	0.75
3	30	0.75
4	40	0.75
Permeability rate(in/min) is: 0.75/10 = 0.075 in/min		

Figure 42: Percolation Rates for TH#2 and image of Test Hole #2.

Test #3 – TH#3- Location: 0338783 m E, 1914359 m N. (Projections are UTM NAD 27 Central, Zone 16N

- Test Date(s): 04/30/2024 Time: 3:30 P.M.
- The time interval between water level measurements was: 10 minutes.
- **TEST DATA**: The test holes were **PRE-SOAKED** for: 1.5 hours, or overnight.

The ground water table was not encountered.

The test was conducted on a field that had already been ploughed and was ready for planting.

The soil permeability class for agriculture is rapid permeability rate.

Test Hole # 3- 0338783 m E, 1914359 m N. (Projections are UTM NAD 27 Central, Zone 16N		
Hole Depth (Inches) – 12 inches		
Interval Number	**Elapsed Time (Mins)**	**Water Level/ Drop (inches)**
Start = 0 min		
1	10	1.50
2	20	1.25
3	30	1.25
4	40	1.25
Permeability rate(in/min) is: 1.25/10 = 0.125 in/min		

Figure 43: Percolation Rates for TH#3 and image of Test Hole #3.

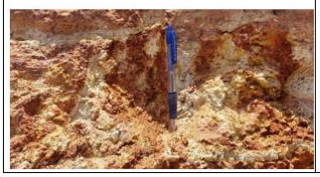
6.3 Soil Profile and Soil Classification

Onsite evaluation of the soils within the development was conducted through the use of test pits and evaluation of road cuts and drainage cuts. Photo documentation and descriptions of these can be found in Table 49 . A field Silt Test was conducted to determine the content by percentage of the clay, silt and sand of the soil found at the development. The Silt Test is used to determine in the field the presence of extremely fine material.

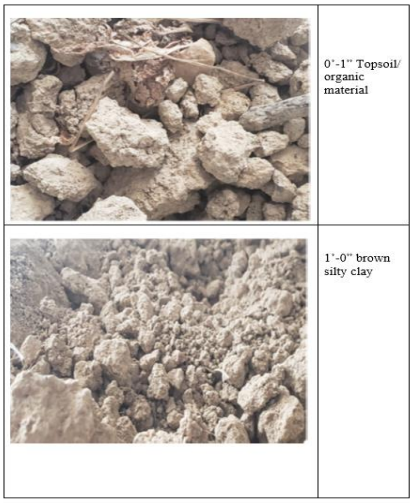
To perform the test a graduated transparent glass bottle is used. The container is filled to one third the depth of the container with soil to be tested. Water is added up to ¾ the depth of the container full. The container is shaken vigorously until all the soil is dissolved. The container is then allowed to stand vertically overnight. During this time the different fine materials that constitute the soil will settle in visible layers with the heavier particles settling first. The percentage of each layer is taken as a percentage of all the layers that have settled.

Table 49: Soil Profiles within the Development Area.

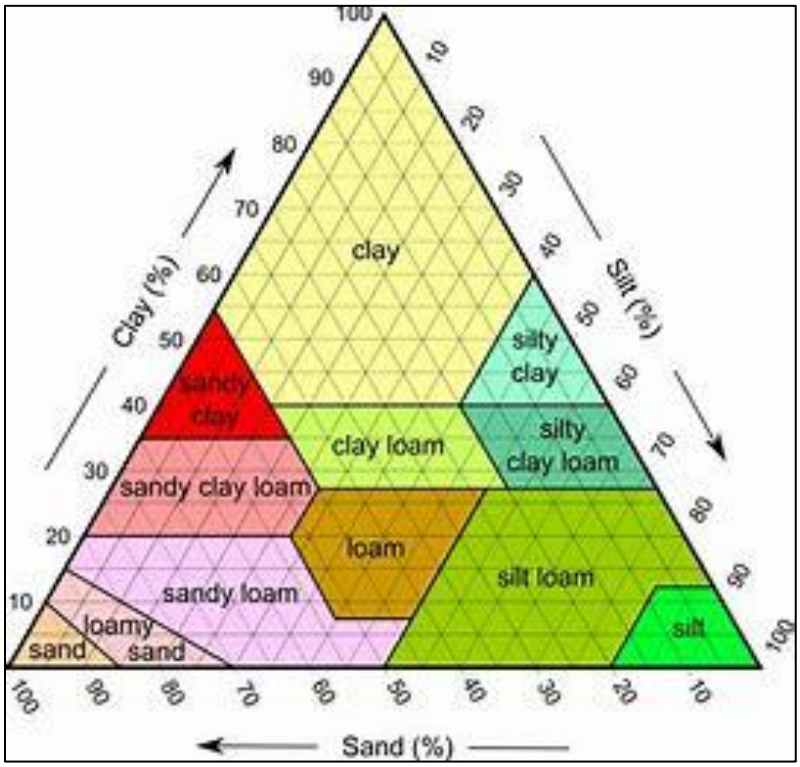
Road Cuts, Test Pits and Drainage Cuts	
Test Pit Description	**Soil Profile**
TEST PIT (DRAINAGE CUT) #1 TP1 Date: April 22, 2024 Location: 0338700 m E, 1918258 m N (Projections are UTM NAD 27 Central, Zone 16N)	 0'-1" Topsoil/organic material 7'-6" brown silty clay
TEST PIT (PLOUGHED LAND) #2 TP2 Date: April 22, 2024 Location: 0338845 m E, 1917464 m N (Projections are UTM NAD 27 Central, Zone 16N)	 0'-1" Topsoil/ organic material 3'-0" brown silty clay

Road Cuts, Test Pits and Drainage Cuts	
Test Pit Description	**Soil Profile**
TEST PIT (Roadside cut) #3 TP3 Date: April 22, 2024 Location: 0343026 m E, 1912496 m N (Projections are UTM NAD 27 Central, Zone 16N)	 0'-1" Topsoil/organic material 2'-10" Silty clay  4'-0" brown mottled clay with ferric oxide modules with silt inclusion
TEST PIT (PLOUGHED LAND) #4 TP4 Date: April 22, 2024 Location: 0340066 m E, 1916152 m N (Projections are UTM NAD 27 Central, Zone 16N)	 0'-1" Topsoil/ organic material 3'-0" brown silty clay

Road Cuts, Test Pits and Drainage Cuts	
Test Pit Description	**Soil Profile**
TEST PIT (PLOUGHED LAND) # 5 TP5 Date: April 30, 2024 Location: 0338771 m E, 1914367 m N (Projections are UTM NAD 27 Central, Zone 16N)	 0'-1" Topsoil/ organic material 1'-0" brown silty clay
TEST PIT (PLOUGHED LAND) # 6 TP6 Date: April 30, 2024 Location: 0338783 m E, 1914359 m N. (Projections are UTM NAD 27 Central, Zone 16N)	 0'-1" Topsoil/ organic material 1'-0" brown silty clay

Road Cuts, Test Pits and Drainage Cuts	
Test Pit Description	**Soil Profile**
TEST PIT (PLOUGHED LAND) # 7 TP7 Date: April 30, 2024 Location: 0336683 m E, 1914878 m N (Projections are UTM NAD 27 Central, Zone 16N)	
Nb: The ground water table was not encountered in any of the Test Pits.	

The following was obtained from the silt field test: the soil contains approximately 90 % of silt, 4 % of very fine sand and 6% of clay. The soil type based on the constituent parts of silt, clay and sand is termed a silt as per the USDA Soil Texture Triangle classification (see Figure 44).



Source: (https://education.nationalgeographic.org/resource/silt/).

Figure 44: Textural Soil Classification (USDA 2024).

The soil material within the areas for the development consist basically of alluvium or sedimentary soil such as silt, clay, sand and detrital matter deposited by running water and which is also referred to as a secondary or transported soil. It is not easily broken when dry. The lumps of soil can be pulverized to soft flour-like texture. When moist it will ribbon and feels smooth and silky. This is consistent with regional soil classifications done by Wright et al, 1959, and the Directorate of Overseas Surveys, 1958.

6.4 Soil Erosion

A potential risk in the areas designated for mechanized agricultural farming is making the soil susceptible to erosion from surface water runoff due to the rains. This can impact the amount of suspended solids that are transported and which end up in the river. The existing areas that have been cleared and have been previously used for farming purposes utilize a ridge and furrow or camber-bed cultivation bedding system which is well suited for lands with slopes of 2% - 4%. This system consists of open surface field drains which are also used to control soil erosion and are connected to outlet drains. The field drains which are wide, shallow and dish shaped are spaced at approximately 120 feet apart. Another practice being conducted to minimize erosion potential of the soils is the use of trash farming which is the incorporation of crop residues into the soil surface layer when ploughed. This increases the overall organic content of the soil and also increases the cohesion factor.

6.5 Soil Fertility

Based on the soil classification above, the land can be generally considered as a Silty soil which is usually more fertile than other types of soil, meaning it is good for growing crops. Silt promotes water retention and air circulation. Too much clay can make soil too stiff for plants to thrive. In many parts of the world, agriculture has thrived in river deltas, where silt deposits are rich, and along the sides of rivers where annual floods replenish silt. “The Nile River Delta in Egypt is one example of an extremely fertile area where farmers have been harvesting crops for thousands of years” (National Geographic, 2024).

Throughout the development there is a variation of soil fertility potential. According to Wright et al, 1959, the northwest and southern portions of the property have low soil potential with a soil

fertility value of 4.5, the central portions of the property have a high soil potential with a soil fertility value of 1.2, and some small sections with the southern portions having medium soil potential with a soil fertility value of 3.

Onsite soil analysis of the crop productivity within the development indicates however that approximately 65% the property has very high crop productivity potential, 32% of the property has high crop productivity potential, and <3% of the property has moderate to low productivity potential (see Figure 45). This result is in keeping with the onsite analysis of the soil profiles discussed in Chapter 7. Figures 46-47.

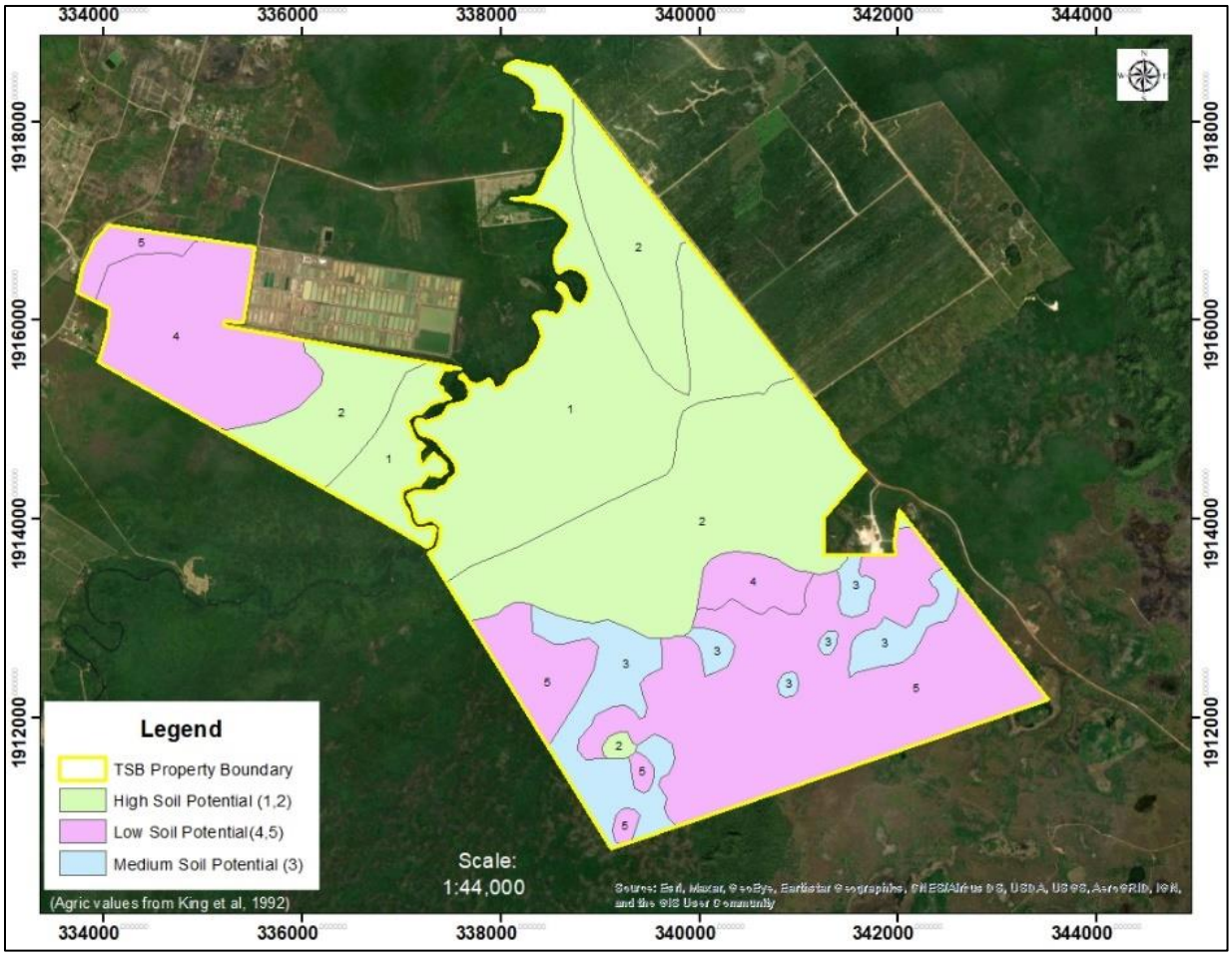


Figure 45: Agricultural Values within the Development (King et al.1992).

6.6 Topography

The development areas are relatively flat with an overall elevation variation of less than 3m across the project site. The areas in the south-east with the outcropping limestone hillocks represent the topographical highs with a maximum approximate elevation of 30m or 98ft above the relative ground level.

The clays and sands are draped around the hillocks with slightly lower elevations through the development as the Sibun River is approached throughout the property. There exist some smaller depression areas that exhibit swampy marsh areas where water accumulates. These depressions are <1m or 3.2ft lower in relative elevation.

6.7 Risks and Mitigations

6.7.1 Associated Risks due to Agricultural Farming

A potential risk in large acreage areas designated for mechanized agricultural farming is the use of large quantities of agrochemicals inputs with the potential to pollute and therefore degrade aquatic and marine ecosystems.

In an effort to minimize this impact the riparian buffer requirement of 66 feet has been voluntarily increased to 150 feet by the SLCCL. The non-clearance of the riverbank will also minimize erosion and decrease the sediments in suspension. The application of chemical fertilizers is to be applied in the required quantities and at appropriate time to reduce the amounts that seep into the soil and potentially to nearby river.

Improper farming practices and soil fertility management could potentially lead to loss in soil fertility through the uptake of key nutrients by the agricultural crops. While often times this may be an issue, in the case of this development where mechanized and semi-intensive farming is required, soil fertility is a key component to the success of the project. The use of rotation farming and planting of crops for nutrient fixing properties and for the inclusion in trash farming would be the main mitigating factor.

6.7.2 Compaction

In mechanized agriculture the use of heavy equipment can lead to soil compaction. This can be mitigated by trash farming, which is the incorporation of crop residues into the soil surface layer when ploughed. In addition to this the company can mitigate this risk by controlling traffic, especially during wet periods, reduce axle load by using balloon tires.

Compaction involves the reduction of pore spaces through the mechanical compression of the soils and through vibro-loading by equipment. The ploughing of the fields for crop productivity and planting along with use of established roads would mitigate against the loss of soil permeability.

CHAPTER 7 AGROCHEMICAL USE AND MANAGEMENT

7.1 Introduction

The prudent use and management of the agrochemical inputs is perhaps the issue with the greatest potential environmental and social concern associated with the operational phase of the project. The use of restricted use pesticides requires that the use of these pesticides be done by certified trained pesticide applicators since these pesticides have the potential to negatively impact human health and the environment. The impacts associated with the use and management of pesticides on human health and the environment have been significantly reduced by initiatives being made in improved regulations and by innovations being made in the manufacturing sector. The production and management of pesticides has seen several notable improvements in recent years such as the following:

a) Development of Biopesticides: There has been a significant shift towards biopesticides, which are derived from natural materials like plants, bacteria, and minerals. These are generally safer for the environment and human health compared to traditional chemical pesticides.
b) Enhanced Formulations: New formulations, such as microcapsule suspensions, have been developed to improve the safety and effectiveness of pesticides. These formulations help in reducing the toxic effects on non-target organisms and the environment.
c) Nanotechnology: The use of nanoparticles in pesticide delivery has shown promising results. This technology allows for targeted application, reducing the amount of pesticide needed and minimizing environmental impact.
d) Integrated Pest Management (IPM): The industry is increasingly promoting IPM practices, which combine biological, cultural, physical, and chemical tools to manage pests in an environmentally and economically sustainable way.
e) Regulatory Improvements: There have been efforts to improve the regulatory framework to ensure that pesticides are used safely and effectively, protecting both human health and the environment.

These advancements have in turn also assisted farmers and applicators in becoming more aware of the need to ensure the safe handling of these agrochemicals thereby reducing risks to their health and the environment.

7.2 Use of Pesticides by SLCCL

The Mennonites of Spanish Lookout in Belize are known for their advanced agricultural practices, which include the use of various pesticides to manage pests in their grain fields. While specific brands and chemical names may vary over time and among different farmers, common types of registered pesticides (in Belize) used in grain farming typically include the following main pesticides.

Herbicides: To control weeds that compete with grain crops.

1. Glyphosate (17 registered Trade Names, Restricted Use Pesticide (RUP) for use by Certified Pesticides Applicators (CPAs) only)
2. Atrazine (10 registered Trade Names, RUP for use by CPAs only)

Insecticides: To manage insect pests that can damage crops.

1. Imidacloprid (12 registered Trade Names, General Use Pesticides (GUP))
2. Chlorpyrifos (6 registered Trade Names, RUP for use by CPAs only)
3. Pyrethroids (Cypermethrin, 5 registered Trade Names, GUP)

Fungicides: To prevent and control fungal diseases in grain crops.

1. Azoxystrobin (11 registered Trade Names, GUP)
2. Propiconazole (3 registered Trade Names, GUP)
3. Mancozeb (23 registered Trade Names, RUP for use by CPAs only)

These are the main pesticides of choice, of which four are RUP for use by Certified Pesticide Applicators only and four are GUP. Although they may use several other registered pesticides as part of their IPM program. The choice of pesticide depends on the specific pests and diseases present, as well as environmental regulations and agricultural best practices. The Mennonites are known for their efficient and responsible farming methods, often following integrated pest management (IPM) practices to minimize the impact of pesticides on the environment. Their IPM program involves the crop rotation method and the rotation of the use of various pesticides so as to avoid pest developing tolerances to any of the pesticide. The crop rotation method utilizing legumes also allows for the cutting down on pest infestations and the use of fertilizers.

A review of the literature on pesticides used specifically for growing grains such as corn, rice, sorghum, and soybean, indicates that although farmers commonly use a variety of pesticides to manage weeds, insects, and diseases, there pesticides of choice used for these crops include the following pesticides shown in Table 50. These pesticides are duly registered in Belize and can be used in these crops, four (4) of which are RUP to be used by CPAs only and the rest are GUP. However, due to the large acreages involved and the amount of application needed, *persons managing these pesticides must have a CPA license*.

Table 50: Pesticides used for Growing Grains approved by the Belize Pesticide Control Board.

Crop	Category	Chemical	Trade Name	GUP/ RUP	Toxicity Class	Colour Code
Corn	Herbicides	Glyphosate	Roundup 35,6 SL Wipeout 35,6 SL	RUP by CPAs only	Precaution	
		Atrazine	Gesaprim 90 WG	RUP by CPAs only	Slightly Hazardous	
		Metolachlor	Dual Gold 96 EC	GUP	Attention	
	Insecticides	Chlorpyrifos	Lorsban 48 EC Pyrinex 48 EC	RUP by CPAs only	Moderately Hazardous	
		Bifenthrin	KILATE 10 EC Seizer 10 EC	GUP	Moderately Hazardous	
		Imidacloprid	SULTAN 20 SL Rotaprid Gold 37.5 SC	GUP	Moderately Hazardous	
		Bt (Bacillus thuringiensis) products	XenTari 10,3 WG NewBt 3.5 SL NewBt 6.4 WP	GUP	Precaution	
	Fungicides	Azoxystrobin	Amistar Top 32,5 SC XSTRATA 25 SC Amistar 50 WG Tandem 40 SC Graduate 47.79 SC	GUP	Precaution	
		Propiconazole	Bumper 25 EC Tilt 25 EC Rimac Propiconazol 25 EC	GUP	Precaution	
		Pyraclostrobin	Regnum 25 EC	GUP	Moderately Hazardous	
Rice	Herbicides	Propanil	Arrozone 57 EC HERBAX 48 EC	GUP	Precaution	

		2,4-D	RIMAXIL 60 SL AGROMINA 60 SL Capture 60 SL Torban 30.4 SL	RUP by CPAs only	Moderately Hazardous	
		Clomazone	Upstage 50 EC	GUP	Moderately Hazardous	
	Insecticides	Lambda-cyhalothrin	KARATE ZEON 5 CS KENDO 2.5 EC Lamdex 5 EC Kung Fu 2.5 EC Jackpot 5 EC KARATE ZEON 2.5 SC ICON 10 WP	GUP	Moderately Hazardous	
		Malathion	Malathion 57 EC (Bestenfelden) RIMALATION 60 EC Malathion 50 WP (Bestenfelden)	GUP	Slightly Hazardous	
		Carbaryl	Carbaryl 80 WP (Drexel)	GUP	Moderately Hazardous	
	Fungicides	Propiconazole	Bumper 25 EC Tilt 25 EC Rimac Propiconazol 25 EC	GUP	Precaution	
		Azoxystrobin	Amistar Top 32,5 SC XSTRATA 25 SC Amistar 50 WG Tandem 40 SC Graduate 47.79 SC	GUP	Precaution	
Sorghum	Herbicides	Atrazine	Gesaprim 90 WG	RUP by CPAs only	Slightly Hazardous	
		Metolachlor	Dual Gold 96 EC	GUP	Attention	
		2,4-D	RIMAXIL 60 SL AGROMINA 60 SL Capture 60 SL Torban 30.4 SL	RUP by CPAs only	Moderately Hazardous	
		Dicamba	BADRUS 27 OD	GUP	Attention	
	Insecticides	Metolachlor	Dual Gold 96 EC	GUP	Attention	
		Malathion	Malathion 57 EC (Bestenfelden) RIMALATION 60 EC Malathion 50 WP (Bestenfelden)	GUP	Slightly Hazardous	
		Carbaryl	Carbaryl 80 WP (Drexel)	GUP	Moderately Hazardous	
	Fungicides	Propiconazole	Bumper 25 EC	GUP	Precaution	

			Tilt 25 EC Rimac Propiconazol 25 EC			
		Azoxystrobin	Amistar Top 32,5 SC XSTRATA 25 SC Amistar 50 WG Tandem 40 SC Graduate 47.79 SC	GUP	Precaution	
		Pyraclostrobin	Regnum 25 EC	GUP	Moderately Hazardous	
Soybean	Herbicides	Glyphosate	Roundup 35,6 SL Wipeout 35,6 SL	RUP by CPAs only	Precaution	
		Dicamba	BADRUS 27 OD	GUP	Attention	
		Metolachlor	Dual Gold 96 EC	GUP	Attention	
	Insecticides	Imidacloprid	SULTAN 20 SL Rotaprid Gold 37.5 SC	GUP	Moderately Hazardous	
		Lambda-cyhalothrin	KARATE ZEON 5 CS KENDO 2.5 EC Lamdex 5 EC Kung Fu 2.5 EC Jackpot 5 EC KARATE ZEON 2.5 SC ICON 10 WP	GUP	Moderately Hazardous	
		Chlorpyrifos	Lorsban 48 EC Pyrinex 48 EC	RUP by CPAs only	Moderately Hazardous	
	Fungicides	Pyraclostrobin	Regnum 25 EC	GUP	Moderately Hazardous	
		Azoxystrobin	Amistar Top 32,5 SC XSTRATA 25 SC Amistar 50 WG Tandem 40 SC Graduate 47.79 SC	GUP	Precaution	

Colour Code:

Category 1: DANGER POISON with a skull and cross bones and band of intense red with the name of the category printed over it.

Category 2: WARNING POISON with a skull and cross bones and band of intense yellow with the name of the category printed over it.

Category 3: WARNING and band of intense blue, with the name of the category printed over it.

Category 4: CAUTION and band of intense green, with the name of the category printed over it.

Source: Pesticide Control Board, 2022.

Table 51 provides important relevant information on the fate of these pesticides in both soils and water and the environmental and health issues of concern.

Table 51: Pesticides' duration in soil and water, and environmental and health issues.

Category	Chemical	Soil Half-life	Water Half-life	Environmental Issues	Health Issues
Herbicides	Glyphosate	2 to 197 days	13.8 to 301 days	Can persist in the environment, affecting non-target plants through spray drift. Toxic to aquatic organisms.	Potential to cause cancer, endocrine disruption, liver disease, and reproductive problems.
	Atrazine	60 to 100 days	168 days in sunlight, 578 days without oxygen	Common groundwater contaminant, disrupts aquatic ecosystems by inhibiting photosynthesis in algae.	Linked to reproductive issues, endocrine disruption, and potential carcinogenic effects.
	Metolachlor	7 to 292 days	Not specifically listed, but generally persistent	Frequently detected in surface and groundwater, posing risks to aquatic life.	Can cause skin and eye irritation, potential long-term effects on human health due to persistence.
Insecticides	Chlorpyrifos	60 to 120 days	7 to 28 days	Highly toxic to birds, bees, and aquatic organisms.	Significant risks to human health, including neurodevelopmental effects in children and acute toxicity.
	Bifenthrin	7 days to 8 months	7 days	Highly toxic to fish and aquatic invertebrates, can persist in the environment.	Can cause skin and eye irritation, potential neurotoxic effects.
	Imidacloprid	40 to 997 days	30 to 162 days	Highly toxic to bees and other pollinators, contributing to colony collapse disorder.	Can affect the nervous system, linked to developmental and reproductive toxicity.
	Bt (Bacillus thuringiensis) Products	Generally short, varies with formulation	Generally short, varies with formulation	Generally safe for the environment, concerns about resistance development in target pests.	Generally safe for humans, minimal health risks.
Fungicides	Azoxystrobin	11 to 17 days	5 to 10 days	Toxic to aquatic organisms, may persist in the environment.	Can cause skin and eye irritation, potential respiratory effects.
	Propiconazole	30 to 173 days	60 to 100 days	Can persist in the environment, toxic to aquatic life.	Can cause skin and eye irritation, potential endocrine-disrupting effects.

	Pyraclostrobin	16 to 40 days	2 to 4 days	Toxic to fish and aquatic invertebrates, can persist in the environment.	Can cause skin and eye irritation, potential respiratory effects

7.3 Fertilizer Use By SLCCL

To better understand the fertility of the present disturbed land, a soil test was conducted by Danaus Consultants in 2024 (Figure 45 and 46) to determine what types and amount of fertilizers are needed to ensure economic crop yields in corn, sorghum and soybean. It also serves to ensure the environment is protected by applying only the needed amount of fertilizer.

7.3.1 Nutrients Tested and their Importance in Crop Production[2]

The essential nutrients for plants are the macro elements: nitrogen (N), phosphorus (P), potassium (K), sulphur (S), calcium (Ca) and magnesium (Mg).

Nitrogen (N as NNO_3): Nitrogen is the most important nutrient for crops, having a dynamic impact on all growth, yield, and grain-quality-determining processes. Thus, increasing nitrogen use efficiency in sorghum would provide opportunities to achieve higher yield and better-quality grain. Soybean has high protein content, which is rich in N, so its needs for N are high. Because soybean can fix its own N, farmers have traditionally taken a "hands-off" approach to N fertilization. Nitrogen is the most yield limiting nutrient for corn production. Corn requires nitrogen for amino acids, protein, and chlorophyll production. Chlorophyll is the key component for photosynthesis. Insufficient chlorophyll content results in reduced yield potential (Parvej, R., Dodla, S. and Foster, M., 2021).

Phosphorus (P): Phosphorus is also a key nutrient in root and shoot development, seedling vigour, and energy. In addition, it helps with metabolic reactions (respiration and photosynthesis) and plays a significant role in the reproductive processes and grain development (Beck's 2023).

Potassium (K): Participates in processes that are essential for their development such as: photosynthesis, cellular respiration, the opening and closing of stomata, water absorption, protein metabolism, the absorption and use of nutrients, the strengthening of the cell wall and enzymatic activation. It is an essential nutrient for correct plant growth and development, and it must be

[2] The use of an agrochemical company's information does not constitute an endorsement of their products.

controlled in any type of crop to ensure the most efficient agricultural production.

Excessive soil potassium levels can result in elevated K levels in grass forage crops, which may be detrimental to animal health. Conversely, very low soil test K levels can reduce plant growth (OSU,2011).

Sulphur (S): One of the primary reasons sulphur is critical to crop production is that it works hand-in-hand with nitrogen in the plant. Sulphur is required to allow the plant to use nitrogen efficiently. Poor nitrogen performance in crops is often associated with lower than optimum available sulphur.

But sulphur is a vital crop nutrient itself. It's an integral part of amino acids, which are essential for plant protein production, and it also contributes to chlorophyll formation (AgroLiquid, 2024). Oilseeds, *legumes, forages* and certain vegetable crops have a high sulphur demand.

Calcium (Ca): Calcium acts as a secondary messenger to regulate the cell cycle and promote proper cell expansion in plants. Calcium ions also help to activate enzymes that facilitate cell division and elongation, contributing to the overall growth and development of the plants (Sul4R Plus, 2024).

Magnesium (Mg): Magnesium plays a key role throughout the whole growth period of a plant. As a central component of chlorophyll, it supports the function of the absorb sunlight during photosynthesis, acts as a phosphorus carrier in plants and is essential for phosphate metabolism and is also needed for cell division and protein formation, activation of several enzyme systems and is an essential component for plant respiration (Agrocares, 2024).

Micronutrients: Micronutrients such as boron (B), chloride (Cl), copper (Cu), iron (Fe), manganese (Mn), and zinc (Zn) are essential plant nutrients taken up by crops in very small amounts, but a deficiency can have profound effects on yield because they perform important physiological functions. Availability of most micronutrients is largely pH-dependent; availability decreases as pH increases (except for molybdenum, which becomes more available as pH increases). Deficiencies rarely occur in soils with pH below 6.5. Soil testing for micronutrients other than boron and zinc is recommended only when a deficiency is suspected. Plant tissue testing may be a better diagnostic tool for micronutrients (Iowa State University, 2024).

Organic Matter: Plays a significant role in crop production and soil health by improving physical, chemical and biological functions in the soil. Increasing levels of organic matter aid in soil structure, water-holding capacity, nutrient mineralization, biological activity, and water and air infiltration rates (Mosaic, 2021).

7.3.2 Soil Analysis Results

The soil analysis results and fertilizer application recommendations are for corn for a yield of 120 bushels per acre and soybean yield of 50 bushels per acre, the two of the three main crops to be planted (Figure 46).

Macro Nutrients: The nitrate nitrogen release of 14.5 lbs/acre is below the 20 to 50 lbs/acre need for a good yield for corn production. Therefore, for corn it is recommended to apply nitrogen. Two test methods were used for phosphorus the OP (used for calcareous soils) and the M3 and the results indicate that the mineral was very low and low respectively, hence it was also recommended to add phosphorus for both crops. Potassium was at the lower bracket of medium at 114 ppm, it is therefore recommended to add this element to both plantings. Sulphur tested at 17 ppm, a little above the half bracket of medium , hence this required a recommendation to fertilize with adding twice as much mineral during corn production when compared to soybean production. Although magnesium soil test rating was at the lower end of medium, no additional fertilization is required for this mineral. The soil pH was recorded at 6.1, hence it is recommended to add dolomitic limestone to raise the pH to a safe range of 6.5 for both corn and soybean planting.

Micronutrients: Iron and copper were found with optimum and medium soil test ratings, respectively and require no further minerals application. Boron tested at 0.5 ppm, a medium rating, hence this required a recommendation to fertilize with adding twice as much mineral during corn production when compared to soybean production. Zink with a low medium rating at 1.6 ppm , it is recommended to fertilize for corn only. For soybean at pH less than 6.2, it is recommended to treat soybean seeds prior to planting with molybdenum as this mineral enhances biological nitrogen fixation in soybean (Abrue-Junior, et al. 2023).

Organic Matter: At 5% it is considered as a high medium soil test rating. Therefore, any reasonable practice that increases organic matter, consistent with the need for the project to generate reasonable profits, is to be encouraged.

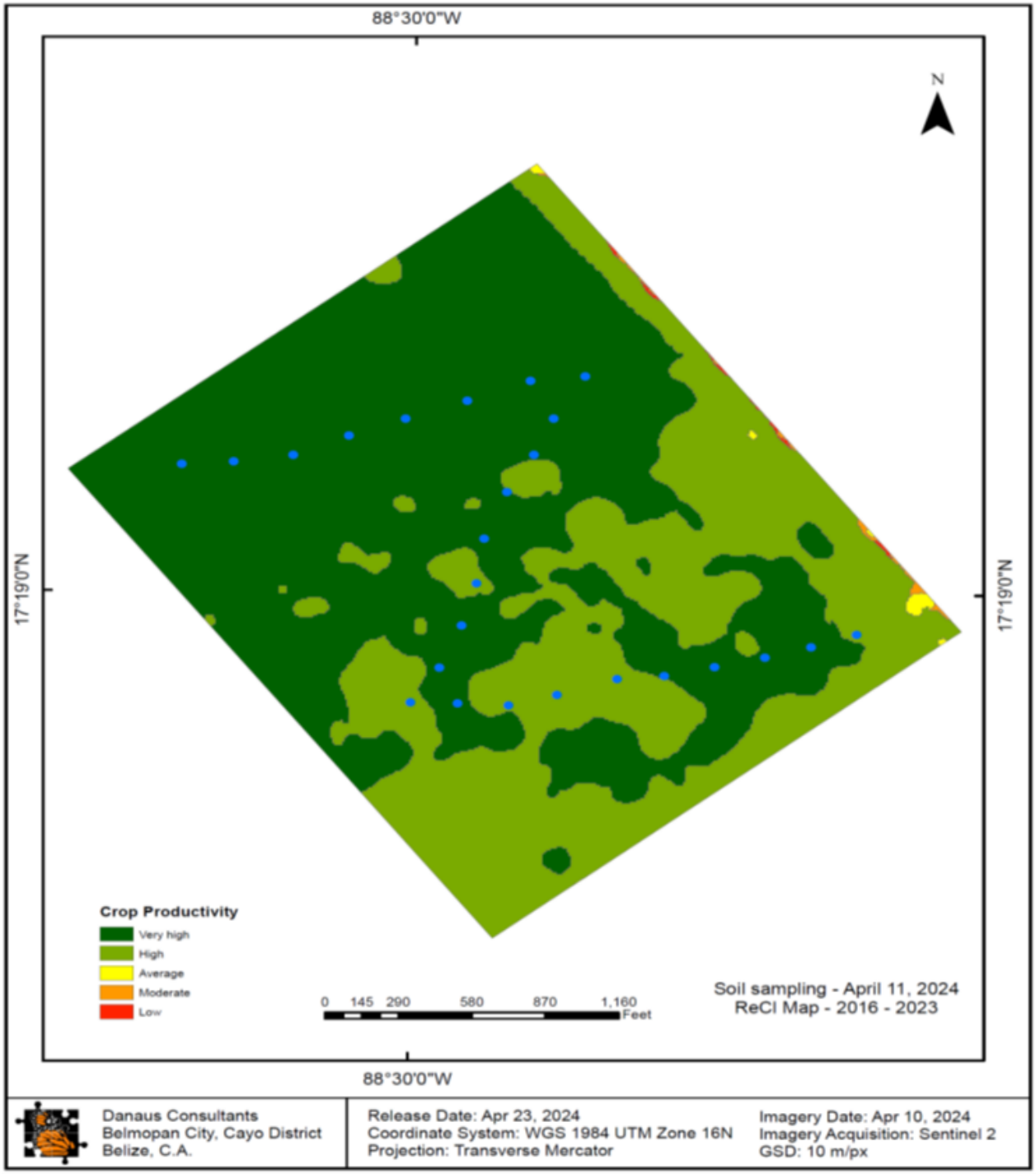


Figure 46: Crop Productivity Map for the Development (Danaus Consultants, 2024).

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SOIL ANALYSIS

Client:	**Grower**	
Danaus Consultants Belmopan City Cayo District Belize	Reginald Reimer	Report date: 4/23/2024 Date Received: 4/11/2024

Field: Tiger Sandy Bay **Sample ID:** DC 0563

Test	Method	Results	SOIL TEST RATINGS (Very Low / Low / Medium / Optimum / Very High)
Soil pH	1:1	6.1	
Buffer pH	SMP	6.83	
Phosphorus (P)	OP	3 ppm	
Potassium (K)	Ex Cat	114 ppm	
Calcium (Ca)	Ex Cat	961 ppm	
Magnesium (Mg)	Ex Cat	102 ppm	
Sulfur (S)	M3	17 ppm	
Boron (B)	M3	0.5 ppm	
Copper (Cu)	M3	1.2 ppm	
Iron (Fe)	M3	143 ppm	
Manganese (Mn)	M3	11 ppm	
Zinc (Zn)	M3	1.6 ppm	
Sodium (Na)	Ex Cat	20 ppm	
Soluble Salts			
Organic Matter	LOI	5.0%	
Estimated N Release		144 lbs/acre	
Nitrate Nitrogen			
Phosphorus (P)	M3	13 ppm	

Calculated Cation Exchange Capacity: **7.0** meq/100g

%Saturation

	%sat	meq
K	4.2	0.3
Ca	68.6	4.8
Mg	12.1	0.9
H	14.3	1.0
Na	1.2	0.1

K/Mg Ratio: 0.34

Ca/Mg Ratio: 5.67

SOIL FERTILITY GUIDELINES

Crop : Corn **Yield Goal :** 120 bu/acre **Rec Units:** LB/ACRE

(lbs)	LIME	(tons)	N	P_2O_5	K_2O	Mg	S	B	Cu	Mn	Zn	Fe
2000		1	146	101	78	0	21	1.0	0	5	2.9	

Crop : Soybeans **Yield Goal :** 50 bu/acre **Rec Units:** LB/ACRE

2000		1	0	105	78	0	11	0.5	0	5	0	

Comments :

Corn

Limestone application is targeted to bring soil pH to 6.5.

· Use dolomitic limestone to correct the pH.

· Greater N efficiency for corn may be achieved by splitting the N application. Apply 1/4 to 1/3 of the N prior to or at planting and the remainder as sidedress when corn is 8-24 inches high.

· For early planted corn or no till corn, apply a starter fertilizer at least 2 inches from the seed at a rate of 10-20 lbs N/Acre and 30-60 lbs P2O5/Acre.

Soybeans

Limestone application is targeted to bring soil pH to 6.5.

· For soybeans on soils with a pH of 6.2 or less, apply limestone as recommended and plant seed treated with molybdenum. Apply 1-2 oz of sodium molybdate (0.4-0.8 oz of elemental molybdenum) per acre as a seed treatment.

M3 - Mehlich 3 SMP - SMP Buffer pH OP - Olsen P Ex Cat - Ammonium Acetate LOI - Loss On Ignition 1:1 - Water pH

Please Note
Whilst every care is taken to ensure that the Results from Analysis are as accurate as possible, it is important to note that the analysis relates to the sample received by the laboratory and is representative only of that sample. No warranty is given by the laboratory that the Results from Analysis relates to any part of a field or growing area not covered by the sample received. It is important to ensure that any soil, leaf, silage or fruitlet sample sent for analysis is representative of the area requiring analysis and that samples are obtained in accordance with established sampling techniques. This report has been generated by Waypoint Analytical Tennessee, Inc.

Figure 47: Test Results of the soil sampling (based on the Productivity Map for the Development, (Danaus Consultants, 2024).

Table 52 provides a list of the six most commonly used fertilizers in the growing of grain crops. Although the SLCCL farmers rely mostly on the natural fertility of the soils they utilize chemical fertilizers to assist in maximizing crop production.

Table 52: List of Commonly used Fertilizers.

Name	Analysis N-P-K-(S)
Diammonium phosphate (DAP)	18-46-0
Potassium chloride (KCl)	0-0-60
Ammonium sulphate	21-0-0-(24)
Urea	46-0-0
Ammonium Nitrate	34-0-0
Zinc Oxysulphate	xZnSO 4 .xZnO

In Table 53, four (4) of the fertilizers used provide nitrogen with one (1) also providing phosphorus. Potassium chloride is used by itself to provide potassium. Zinc Oxysulphate is also used. Sometimes Sulphur is added if the soils pH is and which does not allow the soil to release certain elements as might be needed by the plant. The excessive use of fertilizers can pose several environmental and health issues of concern (Table 47).

Table 53: Summary of Environmental and Health Issues associated with misuse of Fertilizers.

ISSUE	DESCRIPTION
Environmental Issues	Water Pollution: Excess nutrients, particularly nitrogen and phosphorus, can run off into water bodies, causing eutrophication. This leads to algal blooms, hypoxia (dead zones), and loss of aquatic life.
	Soil Degradation: Overuse of chemical fertilizers can alter soil pH, reduce organic matter, and harm beneficial soil organisms, leading to decreased soil fertility and structure.
	Air Pollution: Fertilizer application can release nitrous oxide, a potent greenhouse gas, contributing to climate change. Ammonia emissions can also combine with other pollutants to form particulate matter, affecting air quality.
	Biodiversity Loss: Nutrient runoff can disrupt terrestrial and aquatic ecosystems, leading to a decline in biodiversity (UNEP).
Health Issues	Respiratory Problems: Ammonia and particulate matter from fertilizers can exacerbate respiratory diseases, including asthma and other lung conditions.
	Water Contamination: Nitrate contamination of drinking water can cause health issues such as methemoglobinemia (blue baby syndrome) in infants and other health problems in adults.
	Toxicity: Long-term exposure to high levels of certain fertilizers can lead to toxic effects on human health, including potential links to cancer and other chronic diseases (UNEP).

7.4 Summary of Impacts Associated with Agrochemical Use & Mitigation Measures

Given the impacts associated with the use of agro-chemicals, there is the need to ensure its proper use in accordance with the guidelines and instructions for their proper use, use of application methods that reduces risks to the health of applicators and the environment, proper control and monitoring.

The SLCCL utilizes four (4) methods to apply these chemicals, namely: aerial spraying by duster plane, mechanized application, manual spraying and more recently the use of drones.

7.4.1 Aerial Spraying by Duster Planes

This type of aerial spraying of pesticides offers the least potential impact to the health of the applicators but tends to create a large potential for causing negative environmental impacts due primarily to the dispersal of these chemicals by wind and the potential to impact adjacent water bodies (Figure 48). It is thus important that vegetation buffers be left along the Sibun River to block wind-blown chemicals during aerial spraying. These buffers also trap sediment run-off from the fields that may have traces of chemicals detrimental to aquatic life.

Figure 48: Aerial Spraying of Pesticides by Duster Plane.

Chemicals dispersed into the environment, especially those directly impacting the Sibun River and adjacent Fish farm has negative implications in relation to the health of downstream users and fish life. The lands adjacent and in close proximity to the Sibun River and the Tilapia Fish Farm must exercise extra caution when applying pesticides by duster planes.

This chemical application regime requires close coordination with the weather conditions.

There is a certain weather conditions regime that aerial spraying must abide by so as to avoid contamination of nearby water ways or neighbouring crops. The following guidelines are recommended to reduce the impacts associated with this method:

a. Max wind speed 10 mph. (To avoid drift)
b. Max wind speed for drift sensitive chemical is 5 mph (to avoid damage of plants etc. adjacent to the field by drift).
c. Dew point spread must be over 2 degrees Celsius. (To avoid drift)
d. Relative Humidity must be over 70% (To avoid product evaporation)
e. No spraying 2 hrs. before forecast rain. (To avoid chemical wash-off and run off)
f. No spraying at 100% leaf wetness or immediately after rain (to ensure chemical to leaf retention).

7.4.2 Mechanized Application

There is several specialized equipment that are attached to the tractors which can directly apply either the fertilizer or the pesticides to the crop thus reducing leaching and ensuring that only minimal amounts of the chemical is used due to the fact that it is being directly applied mechanically either to the ground or the root of the crop/plant (Figure 49 and 50).

Figure 49: Mechanical Application of Fertilizer.

Figure 50:Mechanical Application of Fertilizer.

This method seems to be the current most widely used method for the application of pesticides and fertilizers. This method is also efficient and uses less manpower and the applicators are less exposed to heath impacts associated with the various types of pesticides since they are somewhat protected by the enclosed cabins of the tractors sitting above the height of application.

7.4.3 Manual Application of Pesticides

This method is the least utilized as it can be very time consuming and more laborious with the potential to pose the greatest occupational health risks to the applicators (Figure 51). This is only used for minor control of pests. In all instances applicators are required to mix and apply the pesticides in accordance with the instructions and in the instance of restricted use pesticides that the applicators are licensed to do so.

Figure 51: Manual Application of Pesticide.

7.4.4 Application of Pesticides by Drones

Drones are now being used for pesticide application by some of the SLCCL Farmers (Figure 52). Using drone-mounted pesticide sprayers offers several advantages over traditional methods (Source: (The Farming Insider.com- Agri-tech Drone Spraying):

1. Precision and Efficiency: Drones can cover large areas quickly and accurately, thanks to advanced sensors and GPS systems. This ensures precise application of pesticides, reducing waste and improving effectiveness.
2. Cost-Effectiveness: By reducing the need for manual labour and optimizing the use of pesticides, drones can lower overall costs. They can be programmed to target specific areas, minimizing the amount of chemicals used.

Figure 52: Drone Application of Pesticide.

3. Safety: Drones minimize direct exposure to chemicals for farmers, reducing health risks. This is especially beneficial compared to methods like backpack spraying.
4. Accessibility: Drones can easily navigate difficult terrains and small, irregularly shaped fields where traditional ground sprayers or aircraft might struggle.
5. Environmental Impact: With precise application, drones reduce the overall volume of

pesticides used, which can lessen the environmental impact.

A review of recent literature on drone application of pesticides suggests that drone-mounted sprayers represent a significant advancement in agricultural technology, offering a more efficient, cost-effective, and safer alternative to traditional pesticide application methods.

7.5 Other General Mitigation Measures

Using pesticides effectively and safely involves following best practices to minimize risks to human health, non-target organisms, and the environment. Table 54 below provides some general recommendations for best management practices for the most commonly used pesticides.

Table 54: Best Management Practices for The Most Commonly Used Pesticides.

Category	Chemical	Best Practices
Herbicides	**Glyphosate (e.g., Roundup)**	Apply during dry, calm weather to avoid drift. Use appropriate personal protective equipment (PPE). Follow label instructions for mixing and application rates.
	Atrazine	Apply pre-emergence or early post-emergence. Avoid application near water bodies to prevent contamination. Rotate with other herbicides to prevent resistance.
	S-Metolachlor (e.g., Dual Magnum)	Apply pre-emergence to control annual grasses and broadleaf weeds. Incorporate into the soil if possible. Follow label instructions for crop-specific application rates.
	Acetochlor (e.g., Harness)	Apply pre-emergence. Use in combination with other herbicides to manage resistance. Avoid application near water sources.
Insecticides	**Chlorpyrifos (e.g., Lorsban)**	Apply during early morning or late evening to minimize impact on pollinators. Use targeted application methods to reduce non-target exposure. Follow label instructions for PPE and re-entry intervals.
	Bifenthrin (e.g., Capture)	Apply as a foliar spray or soil treatment. Avoid application during windy conditions to prevent drift. Use in rotation with other insecticides to manage resistance.
	Imidacloprid	Apply as a soil drench, seed treatment, or foliar spray. Avoid application during bloom to protect pollinators. Follow label instructions for application rates and timing.

	Bt (Bacillus thuringiensis) products	Apply when target pests are in the early larval stage. Use as part of an integrated pest management (IPM) program. Rotate with other insecticides to prevent resistance.
Fungicides	**Azoxystrobin (e.g., Quadris)**	Apply preventatively or at the first sign of disease. Rotate with fungicides from different chemical classes to prevent resistance. Follow label instructions for application rates and intervals.
	Propiconazole (e.g., Tilt)	Apply at the first sign of disease. Use in combination with other fungicides for broader control. Follow label instructions for PPE and re-entry intervals.
	Pyraclostrobin (e.g., Headline)	Apply preventatively or at the first sign of disease. Rotate with fungicides from different chemical classes to prevent resistance. Follow label instructions for application rates and intervals.

General Mitigations measures

General Tips

1. Read and Follow Label Instructions: Always read the pesticide label for specific instructions on application rates, timing, and safety precautions.
2. Use PPE: Wear appropriate personal protective equipment, such as gloves, masks, and protective clothing.
3. Avoid Drift: Apply pesticides during calm weather to prevent drift to non-target areas.
4. Integrated Pest Management (IPM): Use pesticides as part of an IPM program, which includes crop rotation, biological, and mechanical control methods.
5. Environmental Protection: Avoid application near water bodies and set aside buffer zones to protect aquatic life
6. These pesticides are selected based on their effectiveness against specific pests and diseases and should be used in combination with other pest management practices to optimize crop health and yield.

CHAPTER 8 WASTE MANAGEMENT

8.1 Solid Waste Issues

8.1.1 Background

The country of Belize has taken significant steps to improve solid waste management through the implementation of various initiatives led by DOE and the Belize Solid Waste Management Authority (SWaMA). One such initiative was the construction and management of the National Sanitary Landfill located at Mile 34, George Price Highway. As a result of the national solid waste program, a comprehensive solid waste management plan was implemented for the Western Corridor; and in connection with the Waste Management Plan for Emerging Tourism Areas, various reports were prepared including a Waste Characterization study for the Northern and Southern Corridors in 2016. It also included the establishment of several transfer stations where communities can deposit garbage for either recycling or further disposal at the National Sanitary Landfill.

There are no transfer stations near the project area, but the National Landfill is not very far; being approximately sixteen (16) kilometres or less than ten (10) miles from inside the SLCCL farms and to the national landfill (Figure 53). This renders the site fairly accessible for waste disposal services.

8.1.2 Projected Volume of Waste

At the initial phases of the project, it is expected that some domestic waste may be generated, but this is very little. The other major category of waste is the woody and biomass debris from land clearing during the land preparation phase and subsequently the biomass which is left over from the harvesting of products. However, the biomass is processed into the soil for additional fertilizer during land tilling. During the long-term implementation phase, mostly domestic solid waste will be produced by workers on site.

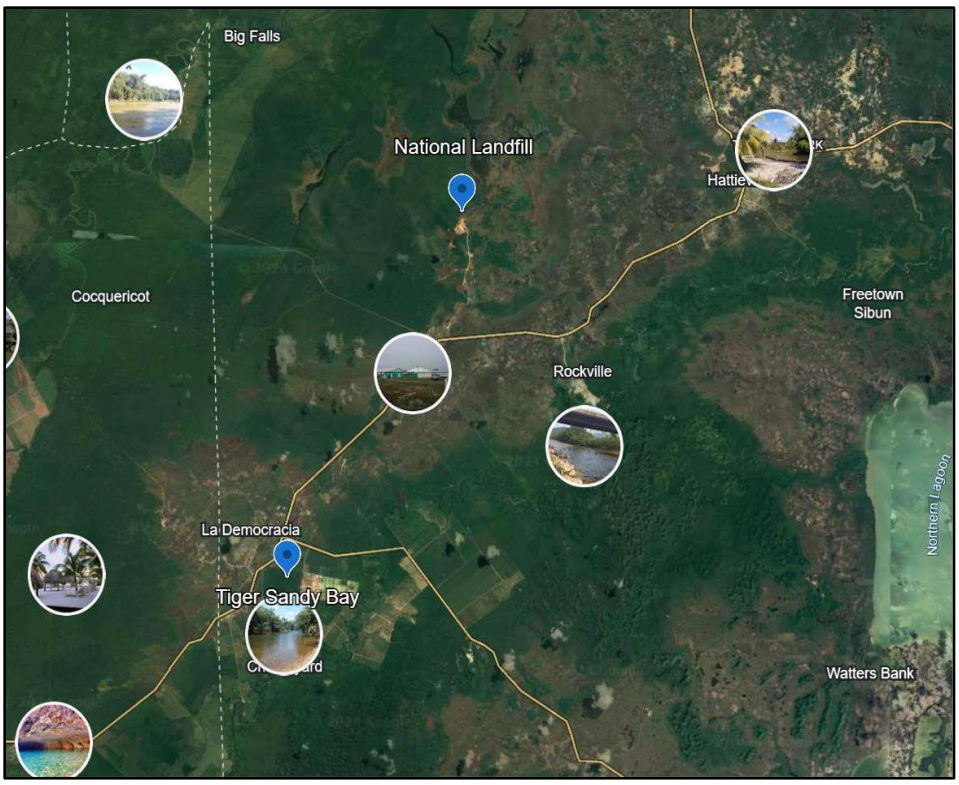


Figure 53: Google Earth Map showing location of SLCCL farm and the National Landfill along the George Price Highway.

Domestic waste generated by employees. There is only one employee and his wife that resides on site and the rest are day workers that visit the site each day. The total number of workers is ten; but this can increase up to 25 during the harvesting period since more workers are on site at this time. Domestic waste includes waste to be generated by employees during their daily routine. Some waste may be produced but this is primarily from the empty containers after their products have been exhausted. Domestic waste includes waste from scrap food (biodegradable), from discarded food containers, plastics for transportation of food and goods, occasionally from expired plastic water bottles (5-gallon type) and other water bottles, paper and cardboard used for packaging and obtained from grocery store purchase, small pieces of rope for various purposes such tying, discarded toilet waste, plastic film, Styrofoam, rags, clothes, shoes, and small quantities of glass from broken containers etc. It is important to note that most pesticides will be mixed and prepared at the headquarters in Spanish Lookout.

Based on existing rates of waste production at commercial establishments (SWaMA), each individual is expected to produce 1.07 kg/per capita per day. Therefore, a work staff of 25 would produce approximately 10.7 kg per day, which may amount to approximately 625 kilograms per month. These volumes, however, may be higher since these rates do not really apply to workers in the field. It is expected that much less volume of waste will be produced, with most of the waste returning in vehicles used by personnel for disposal at the site of origin.

Nevertheless, a solid waste plan incorporates the assumption that an expected 500 -650 kilograms of waste require handling per month. Of this volume a little less than half of all domestic waste produced in Belize is biodegradable waste, mostly in the form of biodegradable material (Table 55). This waste is easily composted and utilized on site and should not be destined for landfill disposal. Therefore, it is safe to estimate that approximately 250 kilograms of waste that is destined for final disposal.

Table 55: Composition of Municipal Waste in the Western Corridor.

Material	Composition (%)
Paper	16%
Plastics	19%
Metals	5%
Glass	8%
Biodegradable Organic Material	33%
Other organic material	14%
Household hazardous waste	2%
Rest	3%

Source: Hydea Limited, Government of Belize, Ministry of Natural Resources and Immigration, Belize Solid Waste Authority. Waste Generation and Characterization Study. July 2017.

Very little commercial waste is expected at the farm site. However, since vehicles, tractors and trailers are used as part of the processes; used tires often accumulate on site. Another source of commercial grade waste is the expired containers that hold fertilizers and pesticides, oils for use on heavy equipment and vehicles, as well as pieces of used piping for water conduits. The generation of this class of waste on site will be significantly reduced since most maintenance and pesticide preparation will be done at the farmers' headquarters in Spanish Lookout.

8.1.3 Solid Waste Management Options

There are two primary options for solid waste management. This includes on site disposal and the other option is for disposal at the national Landfill.

8.1.3.1 Site Preparation Period

The farm site has existing facilities and no new structures are expected to be erected in the future. The construction of facilities normally results in solid waste with a composition of wastepaper from cement bags, waste cardboard from small appliances or other supplies, small quantities of waste plastics, and small amounts of waste construction rubble in the form of concrete and timber. Small quantities of metal wires for the construction as well as expired nails and small pieces of left over rebars also contribute to scrap metal volumes. During the construction period, these wastes are stockpiled for reuse by recycling companies and the rest later removed and transported to its final site. Carts are often used for storage but since debris volumes are small, these may be stored in drums for later transportation to Western Sanitary landfill, where waste collectors sort the garbage and set aside recyclable waste, and dispose non-reusable and non-recyclable waste.

Burning of waste is not necessary and is not recommended, except the burning of organic waste for the small-scale control of pests.

8.1.3.2 Farm Operational Period

a. The Solid Waste Management Plan

The on - site practices allow for the continuation of the existing separation and collection of waste, and presently there is no need for modifications to the practices. Waste is separated as follows: (i) removal of waste food and material that can be used for composting, (ii) removal of any re-usable jars or containers, if and when needed, and (iii) bagging of all other garbage and temporarily storing in the waste cart until full.

b. Organics collection

Waste food scrap that can be composted includes fruit and vegetable waste and peel, cooked or scrap food, leafy green waste, (leaves etc) grass clippings and other plant material. These are collected and composted with the compost material utilized in the field. In reality food waste is

very little because only one employee and his wife live permanently on site, while remaining workers are daily commuters to the site.

c. Collection of Waste Containers

Occasionally, used bottles, such as soft drink, beer bottles, and coffee bottles find itself in the waste stream. Since Belize re-uses most bottles, these are collected and returned as part of the re-using scheme by Bowen and Bowen, or other users. Bottles that are not re-usable are separated and placed in waste bags for temporary storage. Even some plastic bottles are now re-used, some for the sale of products such as coconut oil, cohune oil, honey and herbal medicinal mixtures.

d. Trash Collection

All other non-biodegradable waste is stored daily. Some waste was previously disposed in small piles, but this practice is now being discouraged and the non-reusable and non-degradable waste is to be stored in bins for later disposal.

e. Transportation of Waste

It is recommended that solid waste may be transported every other week or as soon as the garbage drums are filled.

f. The National Sanitary Landfill

The Belize Solid Waste Management Project I set in place a functioning Mile 24 Sanitary Landfill site supported by transfer station for the Belize Central Corridor in Belize City, Burrel Boom Pedro, Caye Caulker and Cayo, excluding Belmopan. The ongoing Belize Solid Waste Management Project II is now financing investments to improve solid waste transport, recovery, and final disposal in towns and villages in the Northern (Orange Walk and Corozal) and Southern (Stann Creek and Toledo) Corridors and in Belmopan.

The landfill is presently managed by the Solid Waste Management Authority under partnership with the private sector. Arrangements for use of the site by the company will be made. This may include a permit or license and the payment of a user fee.

g. Hazardous Waste

Hazardous waste is waste considered hazardous due to their properties primarily since hazardous materials were stored in these containers. These include containers that stored oils, used oils, empty pesticide containers, including pesticides used for household control of pests, and other empty pesticide containers that are used in the agro-industry, and all expired batteries including car batteries.

Recently, the Department of the Environment adopted Crop Protection Guidelines which will be adopted by landowners. These guidelines require certain steps to render containers re-usable and prepare them for recycling, if possible. On site incineration of certain containers are recommended. A copy of these guidelines has been reproduced as Appendix XI.

h. Reporting

This draft management plan for solid waste will be reviewed prior to project commencement. The SWaMA and the Department of Environment will be informed of the commencement of the waste management program. The managers at the transfer station will also be informed so that the necessary fee structure is arranged and that ease of delivery of waste is made possible.

8.1.4 Solid waste Management Potential Impacts

If solid waste is not properly managed, it can lead to deleterious impacts on the environment; especially those investments located near aquatic environments. In this case, the Sibun River runs through the farm, thus requiring measures to protect against contamination of this important water body. These impacts cannot be directly quantified but all efforts must be taken to prevent its contamination with solid waste that can negatively impact the aesthetics of the area and the tourism and ecological value of the river. It is thus imperative that all solid waste generated on site be properly managed and the plan implemented and adjusted as needed.

Table 56 summarizes the potential negative impacts. Potential residual impacts that may arise from solid waste generation have been described as beneficial or adverse, magnitude (high/medium or low), whether the impact would be direct or indirect, its duration as short/medium or long term, and whether the potential impact is avoidable or unavoidable.

Table 56: Summary of Characterization of Potential Impacts from Solid Waste Generation.

Activities	Potential Impacts	Mitigation	Residual Impacts *
Construction activities	Waste spilling/odour	Solid waste management plan to be incorporated	Adverse/medium/direct /medium term/avoidable
Land Clearing	Production of biomass	Reduce to the minimum required for clearing, where possible, use biomass for mulching. Local combustion of biomass is not recommended for environmental and safety reasons. Combustion of biomass contributes to emissions and to the increase of particulate matters that are deleterious to human health.	Adverse/Low/direct impact/ long term/local/unavoidable
Transportation of waste	Risk of spilling	Transport waste using secure containers and ensure that loads are secure	Adverse/Low/Direct Impact/ Medium term/avoidable
Operational Phase	**Domestic/ commercial waste generation**	**Solid waste management plan/recycling/disposal of waste**	**Adverse/medium to low/direct impacts/long term/local/avoidable**
	Odor &and aesthetic impacts	Implement a solid waste plan to avoid odour and loss of aesthetics to the site by avoiding the accumulation of waste and garbage Use biodegradable material for compost and reuse and separate waste that can be recycled and reused	Adverse/medium/direct impacts/long term/local/avoidable
	Contamination of environment/water resources	Adequate and timely collection & and proper storage to avoid leaching	Adverse/long term/direct impact/local/avoidable
	Proliferation of pests	The management plan will ensure that this does not happen by using adequate storage bins with covers.	Adverse/medium/direct /long term/avoidable
	Littering during transportation	Use closed containers for transportation by vehicles	Adverse/medium/short term/avoidable
	Hazardous waste from Batteries or chemicals for pest control	Batteries (used and old) to be safely stored, and waste batteries to be transported to the transfer site for recycling/ practice sound waste management practices to avoid pests	Adverse/Long Term/Avoidable

		infestations/use limited chemical control against pests	
	Social Impacts	The potential negative social impacts of improper waste management have significance mostly related to the potential human health risks from pollution, insect infestation of waste sites, the risk of diseases that come with the improper storing of wastes that gather water for insect breeding grounds etc. Illnesses due to improper waste management can lead to loss of the productive sector (loss of income and economic loss to the company).	Adverse, long term, avoidable

*** Type (beneficial or adverse) Magnitude (high/medium/low)/ direct or indirect/ Duration (short/medium/long term) Avoidability.**

8.2 Liquid Waste Management

8.2.1 Liquid Waste Management Issues

Liquid waste treatment has as its primary objective the treatment of contaminated wastewater to produce an effluent with levels that can be disposed of without causing harm or with significantly reduced harm to the surrounding environment; therefore, preventing pollution. In this case we are dealing mostly with domestic effluent in the form of wastewater from washing of equipment and structures, and from sewage disposal. The issues associated with liquid waste contamination is assessed as minor as very minor amounts will be generated on site, with the expansive area having the absorptive capacity to adequately deal with the amounts generated which will also receive basic treatment prior to their discharge into the receiving environment composed of expansive farmland.

8.2.2 Wate water Treatment options

Using various technologies and methods, wastewater (including sewage) can be treated by the use of physical, chemical, and biological processes to remove physical, chemical, and biological contaminants.

Domestic or municipal wastewater is composed primarily of suspended and dissolved organic and inorganic solids. Among the organic substances present in sewage are carbohydrates, lignin, fats,

soaps, synthetic detergents, proteins, and their decomposition products, as well as various natural and synthetic organic chemicals from the process industries (FAO/UNDP, 1985 Source: FAO, after UN Department of Technical Cooperation for Development (1985).

Depending on water usage, the effluent will have various levels of concentration of these substances. The principal source of liquid waste will be domestic effluent from grey water (washing of buildings, laundry, kitchen and washing of motor vehicles); and from sewage waste. The building housing the security worker and other buildings for the use of management already have existing septic systems. There is no need for additional installation of liquid waste treatment. However, for any future building the options are:

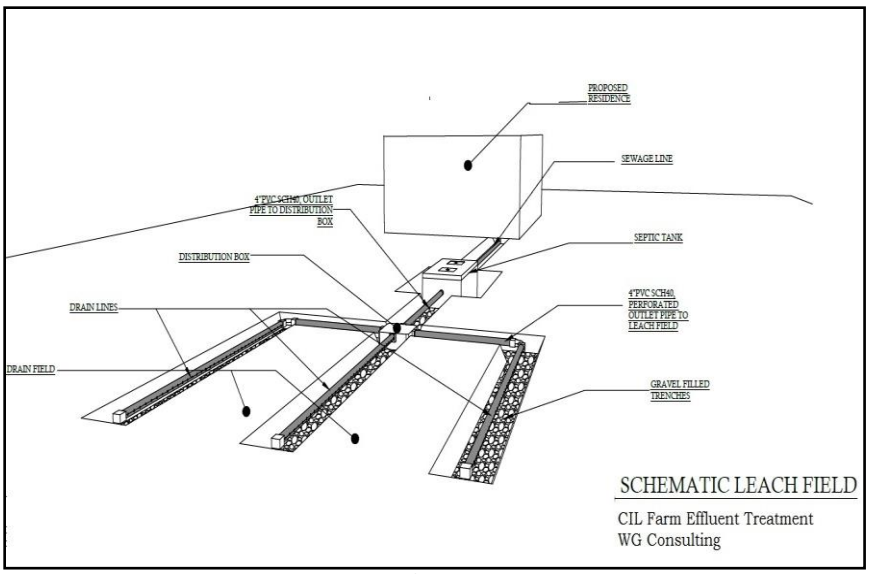
1) Compost toilets. Individual landowners can import these, especially those that may have the resources.
2) Septic tanks but with an added leach field.

Option 1 – Compost Toilet

These toilets do not require the use water for flushing, but degrades waste through a natural process of decomposition into compost, making it one of the most environmentally friendly types of toilets for remote areas. Compost toilets are treated without chemicals and instead, the waste is converted into compost by adding sawdust or similar compost material. These materials are readily available from some farm suppliers. The advantages are several; including the fact that no water is used hence no connection to the water lines is necessary and this also reduces the risk for contamination of the soil and subsurface waters. Another advantage is that small volume of water for the sanitation of hands is needed. The other advantage is that the final compost can be used to support gardens.

Septic tank and leach fields

These will be standard designs but the leach fields will require larger areas for water filtration since part of the area has clays (Figure 54).



Source: Wilderness Group Consulting in LLES for Caribbean Investment Limited, 2024.

Figure 54: Schematic layout of septic tank with adjoining leach field.

Septic systems with leach fields may be more effective at preventing pollution since the wastewater is filtered and degraded by the use of gravel materials carefully laid to allow bacterial action of the wastewater.

8.2.3 Summary of Liquid Waste Impacts and Proposed Mitigation Measures

Table 57 provides a summary of the potential impacts of liquid waste and the proposed mitigation measures.

Table 57: Potential Negative Impacts of Improper Liquid Waste Management.

Activities	Potential Impacts	Mitigation	Residual Impacts *
land preparation	Untreated wastewater /odour	Treat grey water and effluent	Adverse/medium/direct/medium term/avoidable
Land Clearing	Erosion and soil loss	Install drainage systems and install sediment traps using stones and boulders to reduce erosion	Adverse/Low/direct impact/ long term/local/avoidable
Tilling and planting of crops	Possible leaching of fertilizers and pesticides	Use Integrated pest control only when needed.	Adverse/Low/direct impact/ long term/local/avoidable
Long term and continuous farming	**Domestic/ commercial waste generation**	**Solid waste management plan/recycling/disposal of waste**	**Adverse/medium to low/direct impacts/long term/local/avoidable**

Sewage and grey water production	Odor & and aesthetic impacts	Treat effluent and waste using septic tanks and leach fields or compost toilets	Adverse/medium/direct impacts/long term/local/avoidable
	Contamination of ground & water resources	Treat effluent according to recommended guidelines	Adverse/long term/direct impact/local/avoidable
	Proliferation of pests	Drain waters and use sediment control	Adverse/medium/direct/long term/avoidable
	Agrochemical use	Secure agrochemicals to prevent leaks	Adverse/medium/direct/long term/avoidable
	Hazardous waste from Batteries or used pesticide containers	Batteries (used and old) to be safely stored, and waste batteries to be transported to the transfer site for recycling/ practice sound waste management practices to avoid pests infestations/use limited chemical control against pests. Adopt crop protection guidelines for management of empty pesticide containers.	Adverse/Long Term/Avoidable
	Social Impacts	The potential negative social impacts of improper liquid waste management have significance mostly related to the potential human health risks from pollution, insect infestation of waste sites, the risk of diseases that come with the improper storing of wastes that gather water for insect breeding grounds etc. illnesses due to improper waste management can lead to loss of the productive sector (loss of income and economic loss to the company).	Adverse, long term, avoidable

* Type (beneficial or adverse) Magnitude (high/medium/low)/ direct or indirect/ Duration (short/medium/long term) Avoidable.

CHAPTER 9 ROADS AND DRAINAGE

9.1 Access Roads

The proposed development plan allows for several access points to and from the George Price and Coastal Plain Highways. These access points have not been put in place as per the development plan with the exception of one access point in the southern section of the development.

There is an existing established entrance road for the transportation of farm related produce and equipment for the northern and southern section of the development. The northern section has a main access road that is a gate-controlled entrance/exit to the George Price Highway and provides access to the northernmost parcels of the development. The southern section of the development also has an existing established gate-controlled entrance/exit to the Coastal Plain Highway and provides access to the southernmost parcels of the development.

9.2 Gravel Road Network and Roadside-Drainage

The existing main gravel access roads within the development are aligned with the roads as shown on the development map (see Figure 55). The assigned road reserve widths within the development consists of all reserves being 66 feet wide with 2 exceptions these being 37- and 33-feet wide. The access roads can be seen a recent image of the development, Figure 56.

The gravel road network consists of access roads that traverses the entire development starting from the George Price Highway crossing over a timber bridge and from there proceeding onto the Coastal Plain Highway. The access roads are in conformity with the development plan to allow for the movement of the heavy agricultural equipment.

The access roads in the northern section of the development are all-weather gravel road with a carriageway width of 18 feet. The estimated length of the road in this section of the development is approximately 4 miles. The road is elevated one foot above the existing natural terrain. There are no defined drains along the road-side. The agricultural land is sloped away from the road. The gravel access road in the southern section of the development traverses the development in a south-westerly direction from the Coastal Plain Highway and coincides with the development plan for

the road location an estimated distance of one mile. The estimated length of the road in this section of the development is approximately 3 miles.

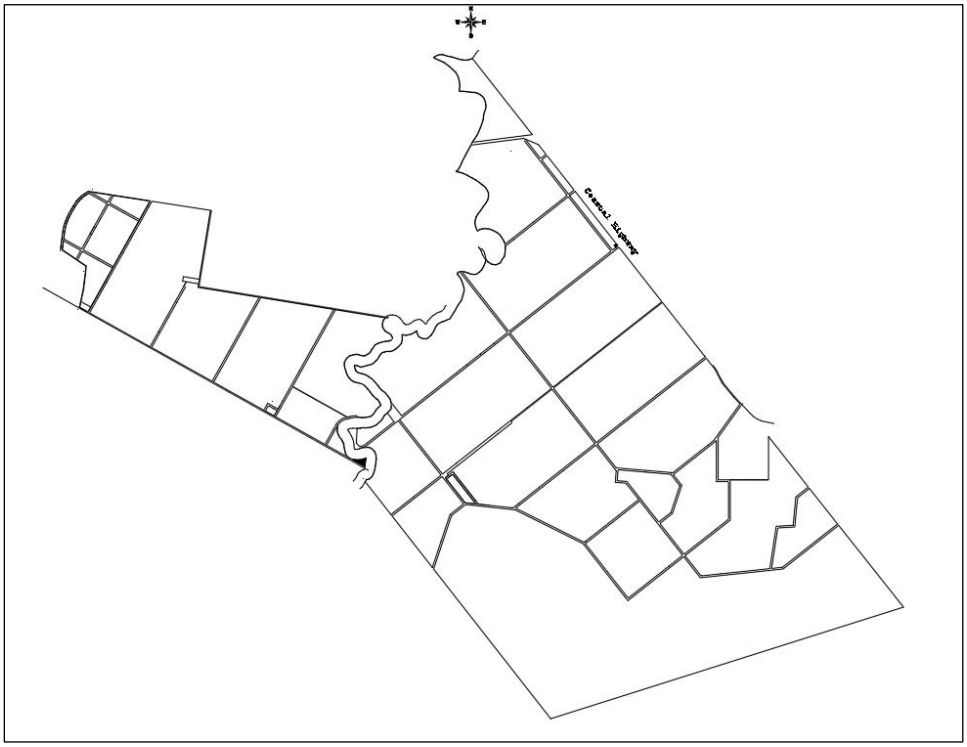


Figure 55: Roads as Outlined in the Proposed Development Plan.

DSUB 2024-05-18 00:00 - 2024-05-18 23:59, Sentinel-2 L2A, True color
Credit: European Union, contains modified Copernicus Sentinel data 2024

Figure 56: Existing Access Roads in the Development.

The 15 miles of new gravel roads in the southern section of the development, are constructed in the areas designated for farming before the clearing of the land takes place. This access road is an all-weather gravel road with a carriageway width of 18 feet (see Figure 57). The recently built roadside-drains had a trapezoidal cross section with a bottom width of 4 feet, a top width of 8 feet and a depth of 3 feet-6 inches. The associated cylindrical culverts in the development are of reinforced concrete, cast iron and High-Density Polyethylene (HDPE) plastic. The culverts do not have headwalls (see Figure 58) but are appropriate for internal agricultural roads.

Figure 57: Image of Typical Access Road and Side-drain within the Development (Newly Built).

Figure 58: Typical Reinforced Concrete Culvert, within the Development.

A section of the southern development is divided by the Coastal Plain Highway and there are no defined existing access points. The existing condition of the road is good since it is the height of the dry season. Which allows for the movement of large cargo vehicles, harvesting equipment and ploughing equipment. Potholes are a minimum along the gravel access roads used by the heavy equipment.

9.2.1 Road Material Source and Volume

Within the development the roads have been opened to varying degrees, therefore there is a requirement for maintenance or upgrade of the internal road network. The estimated thickness of the gravel road is 8 inches. The maintenance of the gravel road would require approximately 2,347 cubic yards of gravel per mile. Considering the overall length of the gravel road to be 18 miles then an estimated 42,246 cubic yards would be required for the maintenance of the gravel road. The road maintenance is conducted by replenishing the displaced gravel surface or adding additional volumes for road elevation. This material is then wet and compacted as required, typically the roads are gentle sloped to aide in drainage.

9.2.2 Material Source/Type

The gravel material used for both maintenance and new road construction is obtained from the Excel Quarry, which is not within the proposed development, but it is however adjacent to the property and is located approximately 1.5 miles from the main entrance along the Coastal Plain Highway.

The material obtained from this quarry is identical to the hillocks found within the development in the area defined as “Quarry Areas” (see Figure 59). These hillocks consist of Barton Creek massive limestone blocks which exhibit some karstification and vugs, with some clay inclusions or seams found within the infill zones. The material is quarried as an all-in unwashed crushed hardcore aggregate, and there is some screening that takes place to provide for the differentiated sizes required (see Figure 60).

Excel Quarry is capable of providing all the material requirements for the road maintenance and upgrade and new road construction. No new quarries or new quarry areas are required for the development.

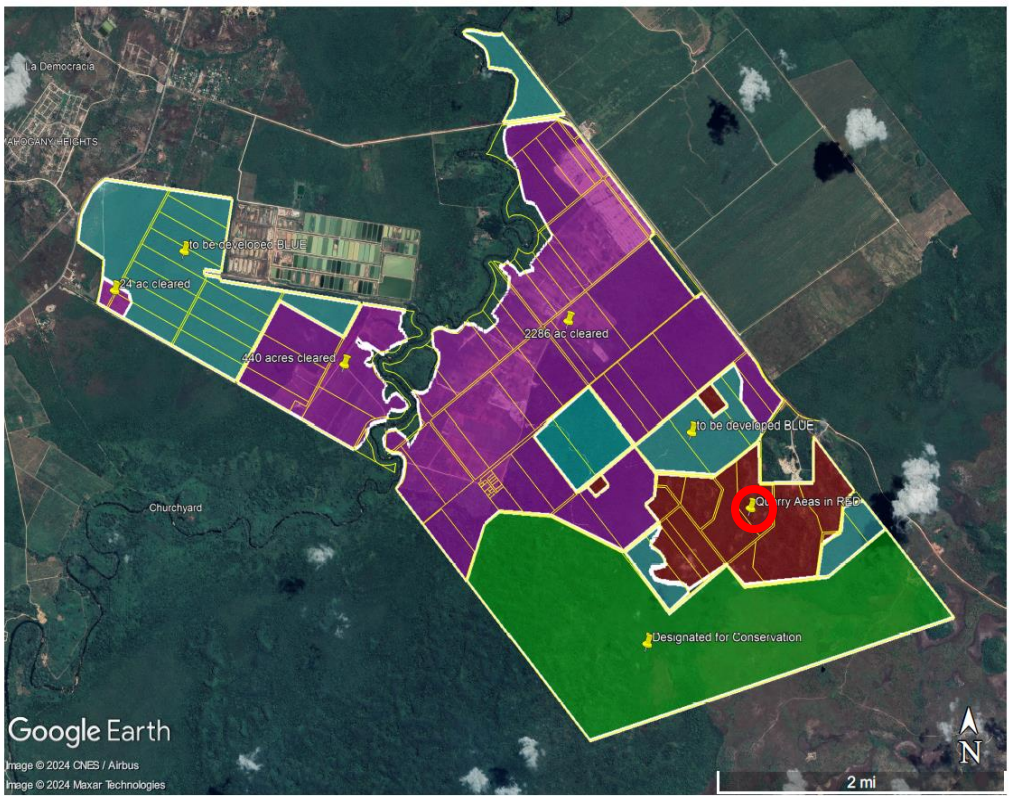


Figure 59: Location Map showing the location of the Excel Quarry (red circle).

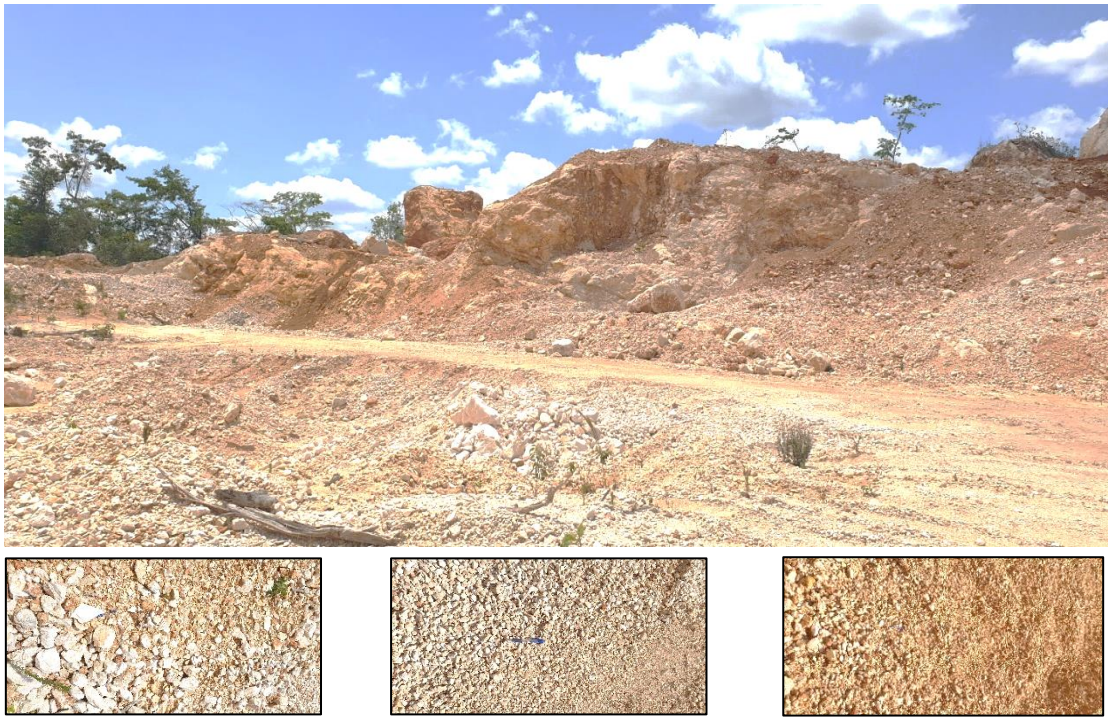


Figure 60: Excel Quarry and Quarry Materials for Road Maintenance and Upgrade (6"minus, ¾" all in, unwashed 3" minus with some clay).

9.3 Drainage Systems

Drainage at the development site and the area designated for agricultural purposes consist of natural drains, field drains and collector/roadside drains. The natural drainage has been interfered minimally.

9.3.1 Field Drains

Field drain's purpose is to allow for the surface water to seep into the ground, the removal of excess surface water to alleviate water logging and to control soil erosion. The existing areas that have been cleared and have been previously used for farming purposes utilize a ridge and furrow or camber-bed cultivation bedding system which is well suited for lands with slopes of 2% - 4%. This system consists of open surface field drains and are connected to collector /roadside drains. The field drains which are wide, shallow and dish shaped are spaced at approximately 120 feet apart. The field drains allow for the easy movement of agricultural equipment from one side to the other.

9.3.2 Outlet/Roadside Drains

The outlet/roadside drains are open drains that are trapezoidal in shape, these drains require the installation of culverts to allow the movement of agricultural equipment from one side to the other. The outlet/roadside drains are presently discharging excess surface water to the Coastal Plain Highway side drains this for the southern section of the development. The final disposal point is the Sibun River.

The main access gravel road had a total of 7 culverts to allow the free flow of excess surface water from the road and fields. None of the culverts had headwalls on either end. A slight siltation was observed in all the culverts; this is an indication that the surface water is carrying away a small amount of silt. The entrance/outlet of the culverts have little or no scouring indicating that the low velocity flow of water during the rainy season. Another indication of the low flow of the storm water are the watermarks in the culverts which show that the flow through the culvert is below 50 % capacity of the culvert.

Table 58 details the type, location and condition of the culverts within the development, and Figure 61 shows a typical concrete culvert.

Table 58: Type, Location and Condition of Culverts within the Development.

Culverts within the Development					
No.	**Culvert Type**	**Diameter**	**Length**	**Location (Projections are UTM NAD 27 Central, Zone 16N)**	**Remarks**
1	Concrete	20 inches	40 feet	0339085m E 1915368 m N	Fair condition but damaged at one end, slight siltation
2	Concrete	20 inches	40 feet	0338615m E 1914995 m N	Fair condition, slight siltation
3	Concrete	40 inches	40 feet	0339452m E 1914616 m N	Fair condition, slight siltation
4	Concrete	40 inches	40 feet	0339955m E 1913977 m N	Fair condition, slight siltation
5	Cast iron	30 inches	27 feet	0338633m E 1913975 m N	Fair condition, slight siltation
6	Concrete	24 inches	28 feet	0338415m E 1913522 m N	Fair condition, slight siltation
7	HDPE Plastic	18 inches	60 feet	0336885m E 1914692 m N	Fair condition, slight siltation

Figure 61: Typical 20 inches Diameter Concrete Culvert.

9.3.3 Bridge Structure

There is one timber bridge within the development that connects the northern and southern sections of the development. The bridge is a composite timber/steel bridge that is 14 feet wide by 130 feet in length. The bridge is divided into 8 spans. The deck of the bridge is made up entirely of timber members. The deck is supported by longitudinal steel beam sections which are then supported by a steel pier/timber piles foundation.

9.4 Potential Environmental Impacts of the Drainage System

The impacts associated with the present arrangement for the discharging of excess surface water is the associated suspended solids and agrochemicals that can enter the body of water. It is recommended that sumps or siltation ponds to be installed in catchment areas prior to entering the Highway drainage system. An alternative to this is to place a 1m x 1m x 1m sediment trap at the exit point of any drains that lead into the Coastal Plain Highway drainage network. The maintenance of these is to be conducted on an as need basis or at a minimum of annually prior to the start of the rainy season. The spoils are to be disposed by spreading on the adjacent fields or low areas.

The mitigation of the potential impacts can be done through a number of mechanisms:

- **Drainage maintenance**. The maintenance of the drainage system is conducted annually prior to the start of the rainy season. The drainage material spoil is spread into the adjacent land where new crops are planted.
- **Culvert maintenance**. The maintenance of the drainage system is conducted annually prior to the start of the rainy season.
- **Bridge maintenance**. The maintenance of the bridge structure requires the installation of deck planks, running planks (running boards) and kerb or wheel guard that are missing or damaged at the deck level (see Figure 62).
- **Bridge maintenance**: The deck support structure is to be inspected to ensure that corroded steel connectors or steel members are replaced as required. The upstream side of the bridge is to be cleared of debris consisting of sticks and tree trunks to ensure that the structural integrity of the structure is not compromised in the event of a storm or flooding condition (see Figure 63).

Figure 62: Timber Deck Maintenance Required.

Figure 63: Timber Bridge Support Structure with Debris Accumulation on the Upstream Side.

Recommendation is made for the periodic inspections of all structures, field drains, roadside drains/ collector drains, culverts and bridge structure before the start of the rainy season. To ensure and protect the structural integrity and flow capacity of existing structures such as bridges or culverts within the system.

Dispose of spoil material from clearing, grubbing, and drainage excavation in a manner that will not hinder the development of travel ways for maintenance and leave the right-of-way in the best condition for the project purposes.

9.5 Potential Environmental Impacts of the Road Network

The access roads that have been constructed in the development are 18 feet wide and has a crushed gravel surfacing. Considering that low volume traffic consisting basically of agricultural equipment and service vehicles use the roads the lane and a half road width road is enough, thus requiring less road construction material. The use of crushed gravel surfacing will protect the road from damage by the elements and minimize the need for periodic maintenance.

The primary impact of the access road upon air quality is the dust and to a lesser extent exhaust emissions which may affect the crops near the road. The road dust is a nuisance rather than a health hazard to the service vehicle drivers and equipment drivers.

The associated impacts with transportation along the adjacent highways will be an increase in the transportation of extra-large equipment and cargo vehicles particularly during the planting and harvesting system. Signs could be installed during these periods to warn the motoring traffic of large vehicles entering or exiting the main access points of the development thus minimizing potential traffic accidents.

The roads will impact the connectivity of the ecosystem, however, several provisions to minimize the impacts will be put in place such as: 1. Since the right-of-way is wide enough the road shoulders will be allowed to revegetate which also protects the shoulder from erosion; 2. The installation of culverts to allow access over the drains; 3. Either side of the natural drains will be allowed a buffer of 10 feet on both sides; 4. The property boundary of the property adjacent to the highways will have 10 feet will be allowed to revegetate naturally together with the highway reserve.

9.6 Impact of Infrastructure on Soil Quality and Land Issues

The road infrastructure in the development is geared towards row crop farming activities only and no farmer homesteads is envisaged. No land issues are anticipated and the property is owned by the SLCCL corporation which has the authority to settle land issues and disputes.

The quality of the soil could be impacted by the potential erosion that can result from road construction this as a consequence of the removal of topsoil and the importing of road construction material. The erosion of road construction material and suspended fluids from the fields can contribute to siltation culverts and drains. The lack of proper maintenance has the potential of causing waterlogging which would affect the soil quality of the fields and damage to the road structure.

9.7 Impacts from Quarrying and Mining Activities

For the road and infrastructure needs within the development the fill, aggregates and construction materials will be obtained from Excel Quarry. This quarry has been identified for a number of reasons; there is an existing mineral right over that location, inclusive of an existing Quarry Management Plan; proximity to the development (<1.5miles); established quarry faces and quarry floor; and ability to supply all the required materials for the development.

It is not expected that any new quarries will be opened for the development to supply materials for the road or any other infrastructure needs. However, the development plan has areas in the south-east designed as future quarry areas. These quarries prior to establishment will require detailed quarry plans and will be required to undergo the screening process by the Mining Unit of the Ministry of Natural Resources, Petroleum and Mining. These plans will address all the issues of vegetation removal, management of dust and sediments, drainage, site rehabilitation upon closures. They will also require environmental clearance from the Department of the Environment

Impacts from quarrying and earth moving activities can be categorized and described under the following:

Direct and Indirect Biological Impacts; the potential direct and indirect impacts from the opening, expansion and operating of the quarry, including the associated impacts of the access roads and trucking, include:

- Loss of vegetation cover, resulting from the clearing of the quarry faces and the quarry floor.
- Loss of small areas of wildlife habitat, constituting roosting, feeding and nesting areas for birds and small animals.
- Increase noise from the operation of quarry machinery and equipment used for processing, extracting and hauling of material, resulting in avoidance of the area by wildlife.
- Increased dust from the quarry operation (blasting, ripping and screening) and transportation, resulting in reduced photosynthesis and plant organic production, in vegetation nearby that may suffer from smothering from dust settling on leaves.
- Indirect biological impacts include increased turbidity of water flowing from the quarry area entering local waterways from runoff waters from rainfall, washing operations or extreme weather events, resulting in deteriorated water quality impacting streams, rivers ponds and the associated aquatic life therein.
- Pollution from oils and other hydraulic fluids from spillage or leakage entering the waterways with resultant impact to aquatic life and fish species.

Direct and Indirect Physical Impacts; these impacts may include but are not limited to:

- Scarification of the landscape and increased erosion potential from exposed surfaces and disturbed materials.
- Reduction or deterioration of land values over the areas used for quarrying and stockpiling, rehabilitation schemes may determine if this is a permanent or temporary impact.
- Indirect physical impacts include the loss in property values of surrounding areas, due to the potential disturbance created by quarries.

Impact on Water Resources; these impacts may include but are not limited to:

- Diversion of natural drainage around quarry areas or access roads.

- Deterioration of water quality in surrounding or adjacent water bodies from increased sediment loads or from other pollutants such as oils and hydraulic fluids from machinery or spillage, in runoff waters.
- Abstraction of waters for washing and processing activities.

Mitigation Measures

In order to limit or address the potential negative impacts from the quarrying and mining activities the following mitigation measures are proposed:

- Adherence to the processes and methods outlined in any approved quarry management plan.
- Adherence to the terms and conditions of any issued Mineral Right.
- Stockpile and reuse of any topsoil in the rehabilitation schemes at the end of mine closure
- Limitation on vegetation removal, with only required areas for quarry access, access to materials, quarry floor, processing area, stockpile area and any management zones, being cleared.
- Use of closed system with collecting ponds for any wash waters, to promote the reuse of waters and limit the volumes required for abstraction.
- Periodic wetting of the quarry floor and access roads to limit dust production.
- Restoration of spoil disposal sites and burrow areas upon mine closure in accordance with the approved rehabilitation plan.
- Establishment of suitable workshop areas, with adequate receptacles for all waste streams, including adequate sanitary facilities.
- Limit extraction to relative ground level to prevent the creation of holes or craters from the areas of extraction.

CHAPTER 10 SOCIAL FACTORS

10.1 Background

This Social Impact Assessment (SIA) is for an Environmental Impact Assessment (EIA) prepared for the Spanish Lookout Community Corporation Ltd (SLCCL) for a proposed farming development of approximately 6719 acres of land located near Runaway Creek and Sibun River along the Coastal Highway in Belize District.

The project proposes to use 6,719 acres of land for planting crops, conservation and mining. Table 59 is a summary of the status of the land use across the property as of March 2024. The location of the agriculture and mining project site is bordered to the west by the George Price Highway (GPH) around the Tiger Sandy Bay entrance to the Sibun River and beyond the southern floodplain of the Sibun River running parallel to the Coastal Highway in the east to around Mile 8.

Table 59: SLCCL land use.

March 2024		
	Acreage	**Percent %**
Acres already Cleared	2751	41
Acres Bush to be Cleared	1301	19
Acres Mountains for Quarry	550	8
Acres Conservation Land	1649	25
Acres River and other Reserves	468	7
Total	**6719**	**100**

10.2 Community Profile

There are two established village communities in the area of influence, namely, Mahogany Heights and La Democracia Villages. There is also the Maya Forest Corridor Coalition who expressed interest in the development.

10.2.1 Mahogany Heights Village

Mahogany Heights information was gathered primarily via personal communication during a meeting with the village council members and residents living near the community center. The

information was corroborated by several other villagers and during the meeting with village council members on June 2, 2024, but credited as personal communication with the first person who shared the respective information. This community profile data collection was a forced imposition, given the absence of an official community profile, and citing the dated 2010 census information would be misleading.

This community was officially established on February 8, 2003 (5 News, 2003) and is situated on mile 32 on the George Price Highway, formerly known as the Westen Highway. The village house infrastructure shows varying degrees of appearance, ranging from dilapidated to affluent housing. The main access road into the village is a dirt road with potholes stretching for approximately 1.5 miles. There are a few paved roads within the village, one being the "main road," which is lined on both sides by churches, the school, the community center, the police substation, and the park. The residents engaged were approachable, friendly, and willing to share when asked about the village. (Figure 64. Field visit, June 2, 2024).

Figure 64: L-R: Jermain Sanchez (Chairman), Raquel Trapp (Counciler), Fermin Olivera, (Team Social Specialist).

Mahogany Heights Population: 869 persons (males 411 and females 548). (Statistical Institute of Belize, 2022).

10.2.1.1 Work/Employment

Residents of Mahogany Heights are working-class people who work mostly in the neighbouring cities of Belize and Belmopan, doing varying types of jobs in the retail and serving industry and at professional and public service levels. Most residents use public transport to and from work, while others use private vehicles. S. Copious, personal communication, June 2, 2024.

10.2.1.2 School

There is a lower-division Anglican primary school consisting of infant grades up to standard 3 with an approximate enrolment of between 70 and 100 students. The upper division of this primary school is located in La Democracia Village, approximately 2.5 miles away. This school arrangement requires students to travel between the two villages to attend primary school. Free school bus transportation to attend school is provided by the Government of Belize. There are no high schools in the village. High school students attend schools in Belize City or Belmopan City. A free high school bus is available, but it only travels to Belize City. J. Sanchez, personal communication, June 2, 2024.

10.2.1.3 Health

There is a community health post in the village with a full-time resident nurse who provides basic nursing services, including for residents from La Democracia Village. The health post also supports the mobile health service that visits once per month. For emergency medical services, the nearest regional hospitals are in Belmopan City (Western Regional Hospital) and Belize City (Karl Heusner Memorial Hospital). R. Trapp, personal communication, June 2, 2024.

10.2.1.4 Water

There is a rudimentary potable water system consisting of a drilled well and concrete water reservoir that supplies the village. This water is used for domestic purposes and for drinking, the latter in some instances. While there is a metered system, residents currently pay a flat rate of $10.00 BZ regardless of monthly consumption. There is also access to bottled water in the community via the local grocery stores. Some residents also collect rainwater for household use, including drinking. S. Copious, personal communication, June 2, 2024.

10.2.1.5 Churches

The community has a presence of various faith denominations: Baptist, Jehovah's Witness, Methodist, Anglican, Nigerian, and Assembly of God. R. Trapp, personal communication, June 2, 2024.

10.3.1 La Democracia Village

La Democracia's information was gathered primarily via personal communication during a public community consultation meeting held on June 2, 2024. In attendance were the village chairman and a councillor (Figure 65). This community is closest to the zone of influence. The public consultation had the full endorsement of the chairman, who suggested the venue, date, and time for the meeting. He assumed responsibility for notifying the community members. The target number of participants expected to attend was 20. Attendees totalled 5 community members. While there is no justification for the poor turnout, the village chairman attested to inviting numerous residents who allegedly said they would attend. The apparent phenomenon of low turnout for such consultations may be a social issue worth researching, given the importance of such consultation activities.

The literature provides a paucity of information about this village, including searches on government sites. Digital information that was readily available focused on tourism-related and real-estate activities near and around this community.

Figure 65: Public Community Consultation, La Democracia Village.

La Democracia Population: 301 persons (males 167 and females 133) (Statistical Institute of Belize, 2022).

10.3.1.1 Work/Employment

Residents of La Democracia are working-class people who work mostly in the neighbouring cities of Belize and Belmopan, doing varying types of jobs in the retail and serving industry. There are a number of construction companies and workers that operate from the village. There are many professionals working in medical, educational, and law enforcement. Most residents use public transport to and from work in the cities, while others use their private vehicles. E. Lewis, personal communication, June 2, 2024.

10.3.1.2 School

There is an upper-division Anglican primary with standards 4 through 6. The lower division of this primary school is located in Mahogany Heights Village, approximately 2.5 miles away. This school arrangement requires students to travel between the two villages to attend primary school. Government of Belize provides free school bus transportation to attend school. There are no high schools in the village. High school students attend schools in Belize City or Belmopan City. A free high school bus is available, but it only travels to Belize City. T. Brakeman & J. Sanchez, personal communication, June 2, 2024.

10.3.1.3 Health

There is no community health post in the village; however, a nurse who resided in the village provided basic nursing services. The nearest health center is located in Mahogany Heights, which is responsible for providing services to La Democracia. For medical emergency services, the nearest regional hospitals are in Belmopan City (Western Regional Hospital) and Belize City (Karl Heusner Memorial Hospital). T. Brakeman, personal communication, June 2, 2024.

10.3.1.4 Water

There is a rudimentary potable water system consisting of a drilled well and concrete water reservoir that supplies the village with free water. This water is used for domestic purposes and drinking. There is also access to bottled water in the community via the local grocery stores.

Rainwater collection is not a common practice. P. Lewis, personal communication, June 2, 2024.

10.3.1.5 Churches

The community has a presence of the Baptist and Adventist denominations. T. Brakeman, personal communication, June 2, 2024.

10.4 Methodology

10.4.1 Data Collection

The EIA's terms of reference (TOR), specifically in section 10 titled "Social Factors," enumerated and described the data required. The strategy used to collect the data was founded on the Locality Development Model and Nonprobability Sampling.

The Locality Development Model, also known as the Community Development Model, seeks the broad participation of community members to express their views and to dialogue on the issue(s) under consideration (Zastrow, 2014). To obtain broad feedback, 1) a custom survey instrument (questionnaire) was developed to collect information from individual community members, 2) meetings with duly elected local government village representatives were held, and 3) a public community consultation was held in one of the buffer villages, namely La Democracia.

The social information required, as described in the TOR, was largely of a qualitative nature. There are two villages that buffer the rural zone of influence: La Democracia Village and Mahogany Heights. This relatively small rural area, both in size and population, along with the qualitative data required, allowed for the adequate use of nonprobability sampling, specifically 1) Availability Sampling, targeting residents and businesses, 2) Purposive Sampling for local government representatives, and 3) Snowball Sampling for nongovernment organizations (NGOs), community-based organizations (CBOs) and government organizations (GO). All stated nonprobability sampling methods are recognized as qualitative data collection methods and appropriate for use in instances of this nature that do not require probability sampling (Grinnell & Unrau, 2014). A familiarization tour of the general area, including the zone of influence, was undertaken to confirm the feasibility of the data collection strategy.

The social specialist on the team led the data collection process, which was primarily collected using an interview-style methodology. For the two small group meetings, a semi-structured interview questionnaire was developed and used. The meetings were led by a primary facilitator A field logbook was kept throughout the execution of this work. It was used sparingly to verify nominal level data, record meeting appointments, and initial contact information, to name a few.

10.4.2 Stakeholder Mapping

Two reconnaissance field trips were conducted in the zone of influence, and initial contact was made with the following entities, who were provided with an oral brief of the upcoming survey to be done regarding the EIA and asked to share about other potential stakeholders. See Table 60.

Table 60: Stakeholder Mapping.

#	Identified Stakeholder	Relevance
1	La Democracia Village Chairman.	Local government of 2nd largest buffer community.
2	Mahogany Heights Village Chairman.	Local government of largest buffer community.
3	The Belize Zoo.	Organization in close vicinity along the Phillip Goldson Highway.
4	Monkey Bay Wildlife Sanctuary.	Environmental organization adjacent to the zone of influence along the Phillip Goldson Highway.
5	Tropical Education Center.	Environmental organization in close vicinity, along the Phillip Goldson Highway.
6	Fein Catch.	Tilapia farm adjacent to the zone of influence along the Coastal Highway.
7	Amigos, Restaurant and Bar.	Business in close vicinity along the Phillip Goldson Highway.
8	Cheers, Restaurant and Bar.	Business in close vicinity along the Phillip Goldson Highway.
9	National Institute of Culture and History (NICH).	Government organization with responsibility for cataloguing and conservation of historical artifacts, among other roles and responsibilities.

Stakeholders' identification and selection were made using nonprobability sampling: 1)

Availability Sampling to select residents and businesses, 2) Purposive Sampling for local government representatives, and 3) Snowball Sampling for nongovernment organizations (NGOs), community-based organizations (CBOs), and government organizations (GOs) (Table 61 and Figure 66).

Table 61: Sample, # of Responders, Relationship with Zone of Influence, and Method of Data Collection.

Sample	# of Responders.	Relationship with zone of influence.	Method of data Collection.	Evidence
Chairman, La Democracia Village.	1	Local government of 2nd largest buffer community and closest to the zone of influence.	Survey Questionnaire.	Completed survey Instrument.
Public Consultation Meeting, La Democracia Village Residents.	5	Buffer community and closest to the zone of influence.	Public consultation meeting.	Signed attendance register and raw meeting notes.
Chairman and Village Council Executives and a resident of Mahogany Heights.	3	Local government of largest buffer community.	Meeting.	Raw meeting notes.
Tour guides and residents of buffer communities.	4	Tour guides using the cave system.	Survey Questionnaire.	Completed survey Instruments.
Adjacent Environmental Organization.	2	Environmental organization adjacent to the zone of influence.	Survey Questionnaire.	Completed survey Instruments.
Business Organizations.	3	Adjacent to the zone of influence.	Survey Questionnaire.	Completed survey Instruments.
National Institute of Culture and History (NICH).	1	Government organization with responsibility for cataloguing and conservation of	Meeting	Raw meeting notes and follow-up email are available.

		historical artifacts, among other roles and responsibilities.		

Total number of participants = 19.
Total number of completed survey questionnaires = 10.
Total number of meeting participants = 9.

Note: All stakeholders recorded in the mapping exercise, See Table 46 above , were contacted. Several did not participate in the survey exercise. After three follow-up attempts; one via a phone text message and two in-person visits to each entity over a period of three weeks between the 18th of May through the 8th of June 2024, further efforts were abandoned.

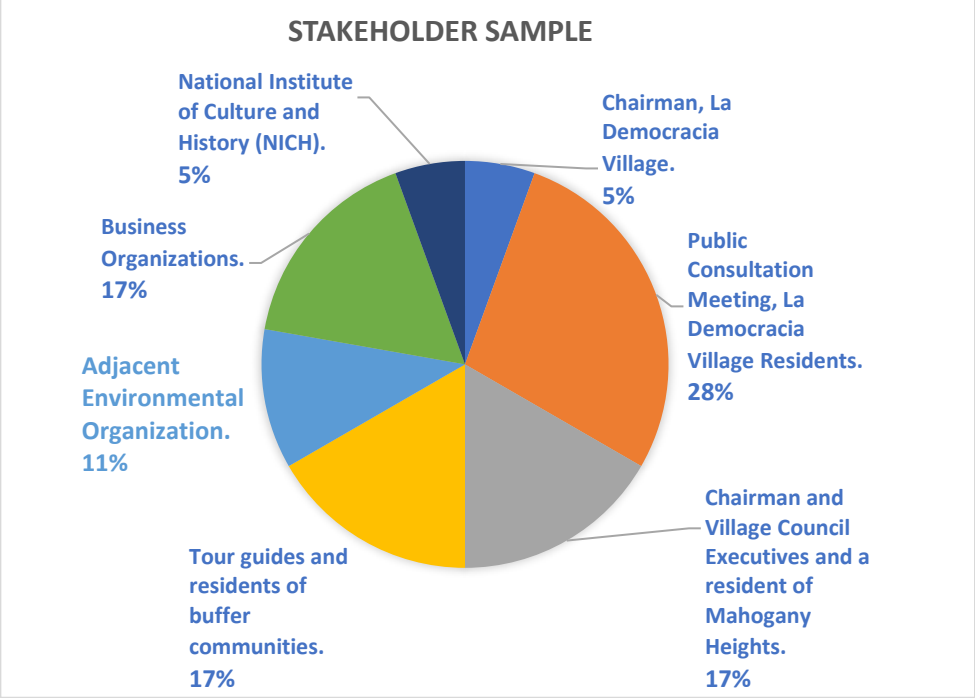

STAKEHOLDER SAMPLE
National Institute of Culture and History (NICH). 5%
Chairman, La Democracia Village. 5%
Business Organizations. 17%
Public Consultation Meeting, La Democracia Village Residents. 28%
Adjacent Environmental Organization. 11%
Chairman and Village Council Executives and a resident of Mahogany Heights. 17%
Tour guides and residents of buffer communities. 17%

Figure 66: Stakeholder Sample.

10.5 Survey Instruments

Two survey instruments were used to collect data. A survey/questionnaire instrument to collect micro-level information and a semi-structured questionnaire for use with small groups in meetings or public consultations.

A tailored survey instrument/questionnaire was developed to collect micro- and individual-level information. The instrument contained 1) an informed consent section, 2) an acreage description of Tiger Sandy Bay, and 3) a development map of the site. See Appendix XIV Survey Instrument/Questionnaire for details.

The survey instrument/questionnaire was to be administered in an interview-style setting, but in several instances, it was completed as a self-report. The instrument was not field tested. The instrument asked 14 questions ranging from basic nominal and Likert/ranking data. Each question aimed at collecting the specific information as prescribed in the terms of reference (TOR) in connection with this EIA and specifically Section 10. SOCIAL FACTOR.

"This section is aimed at documenting the interests of the community…":

- *Provide information of the nearest community…demographics…cultural customs.*
- *Describe…issues of displacement in relation to cultural customs.*
- *Outline net benefits...on residents…employment and other economic opportunities.*
- *Health risks, hazards, expressed concerns of stakeholders…"*

The other data collection instrument used was a semi-structured questionnaire guide to be used in small groups and during public consultations. See Appendix XV: Semi-Structured Meeting Questionnaire. The meetings were led by a primary facilitator assisted by a note-taker. See Appendix XVI: Transcript of Meeting Notes with Village Council Executives and Public Meeting. A field logbook was kept throughout the execution of this work. It was used sparingly to verify nominal level data, record meeting appointments, and initial contact information, to name a few.

10.6 Data Analysis

10.6.1 Stakeholders Sample

The stakeholders were grouped by occupations in relationship with the zone of interest (Figure 67). A complete list of participants and contact information is available. See Appendix XVII: List of Participants.

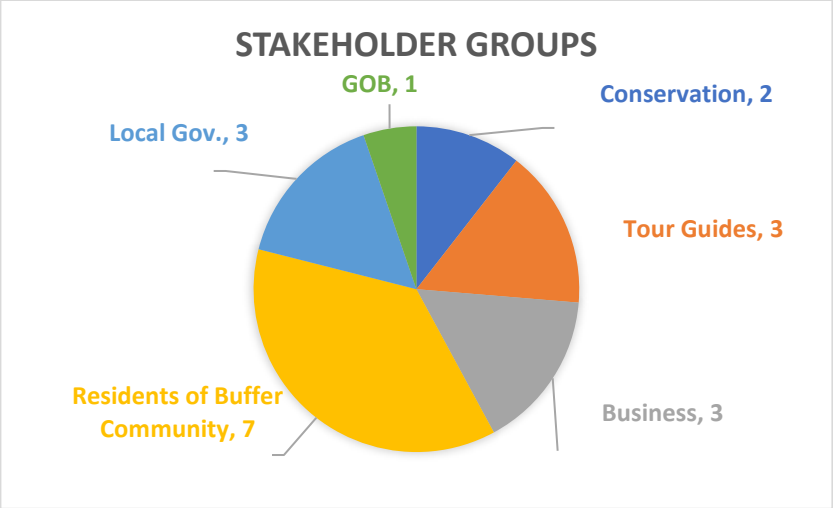


Figure 67: Stakeholder Groups.

The nineteen (19) participants can be considered high-quality stakeholders, given their close connection with the zone of influence. Ten (10) of the nineteen participants completed the survey/questionnaire. This data constitutes the bulk of the information requested in the social impact assessment (SIA) and was compared with information emanating from meetings and public consultation. This two-tiered data collection method, if congruent with each other, increased the reliability of the data. A comparison of the two groups of data revealed significant congruence.

10.6.2 Relationship with the Area of Influence and Duration

Responders' relationship with the area of influence and length of time suggests longevity being in the area and also in their respective business endeavours/occupations while in the area of influence (Table 62). These self-reported qualities/variables of the responders increase the quality of the sample. Many commented, knowing the previous owner, his favourable disposition toward the community in using the property, and his favour for wildlife conservation.

Table 62: Responders, Relationship with the area of influence and Length of Time.

# of Responders	Relationship with area of influence.	Average length of time in years.
2	Adjacent Wildlife Sanctuary.	16
3	Tour guides who work in the caves, river, and trails.	14
3	Business adjacent and in close proximity.	17
2	Resident in Buffer Community.	36

10.6.3 Level of Familiarity with the Development Project

Responders were asked to rate their familiarity from on a scale ranging from (Low) Minimal, Fair, Good, Excellent (High) after the Sandy Bay information was shared and briefly discussed (Figure 68). Thirty percent reported minimal familiarity stemming from two perspectives; had not seen the land preparations (older sedentary responder) and another from not knowing what crops were going to be planted and if irrigation was being contemplated. Higher familiarity with the development project stemmed from having seen the land clearing, having seen previous crop production, and customary usage of the zone of influence. This suggests that individual experience of witnessed developments may have influenced the level of familiarity. This adds value to the quality of the sample.

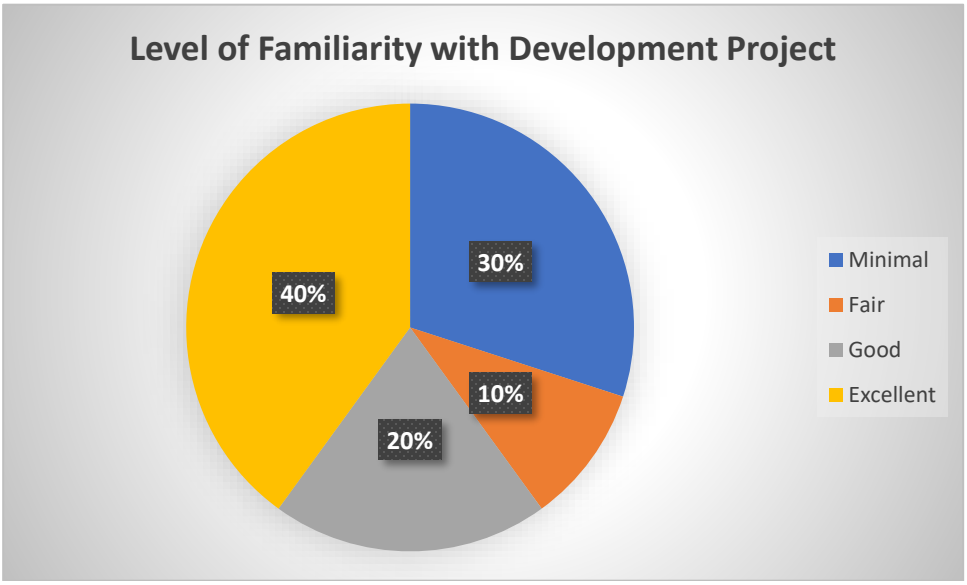


Figure 68: Level of Familiarity with Development Project.

10.6.4 Customary Livelihoods

The top five customary livelihoods that occur within the project area and are listed in the majority order as reported: 1) hunting, 2) fishing, 3) cave and river tours, 4) recreational use of the river, (Figure 69), and 5) washing clothes; this latter use was explained as an associated opportunity some resident took while using the river for recreation. Washing of clothes or laundry was primarily done at home.

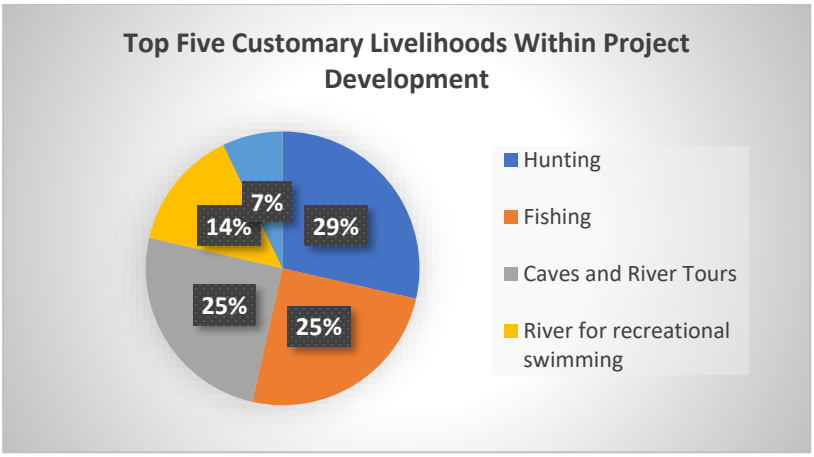


Figure 69: Top Five Customary Livelihoods.

Hunting was the top livelihood at 29%. This consisted of small seasonal game hunting, primarily for subsistence use, with a smaller percentage sold to locals, including restaurants in the area.

Tied for second place in livelihoods were fishing and cave and river tours, with 25% each. Fishing, like hunting, was primarily done for substance use. Caves and river tours can be considered the most commercially lucrative of all the identified livelihoods; all responders who identified themselves as tour guides were doing this as their primary employment for many years.

Monkey Bay Wildlife Sanctuary provided data on visitors for the period 2021 through 2024 (Table 63). Their calendar year is from January to May. Their 2021 year may reflect a post-COVID-19 recovery that is followed by an upward trend. However, 2024 is an anomaly, and upon further clarification, given the wildfires in the area in March 2024, Monkey Bay Wildlife Sanctuary actively discouraged visitors to their site, A. Coc, personal communication, June 20, 2024.

Table 63: Visitors to Tiger Sandy Bay Cave 2021-24.

Number of Groups and visitors that have visited Tiger Sandy Bay Cave in the SLCCL land during the past 4 years through Monkey Bay Wildlife Sanctuary:		
Year (Jan. to May)	# of Groups	# of Visitors
2021	3	33
2022	5	62
2023	6	89
2024	4	28
Total:	**18**	**212**

Source: Arvin Coc, Protected Areas Manager, Monkey Bay Wildlife Sanctuary, May 2024.

The Sibun River, which passes through the zone of the proposed development, and the caves

located on the property itself are the most significant sources of customary livelihoods for the communities in the immediate vicinity.

10.6.5 List of General Concerns with the Proposed Development

River pollution, deforestation, and prohibition to access the caves and river are the top reported concerns, followed by river water extraction, smoke pollution due to the burning of fallen forests, destruction of river buffers, and wildfires (Figure 70 and Table 64).

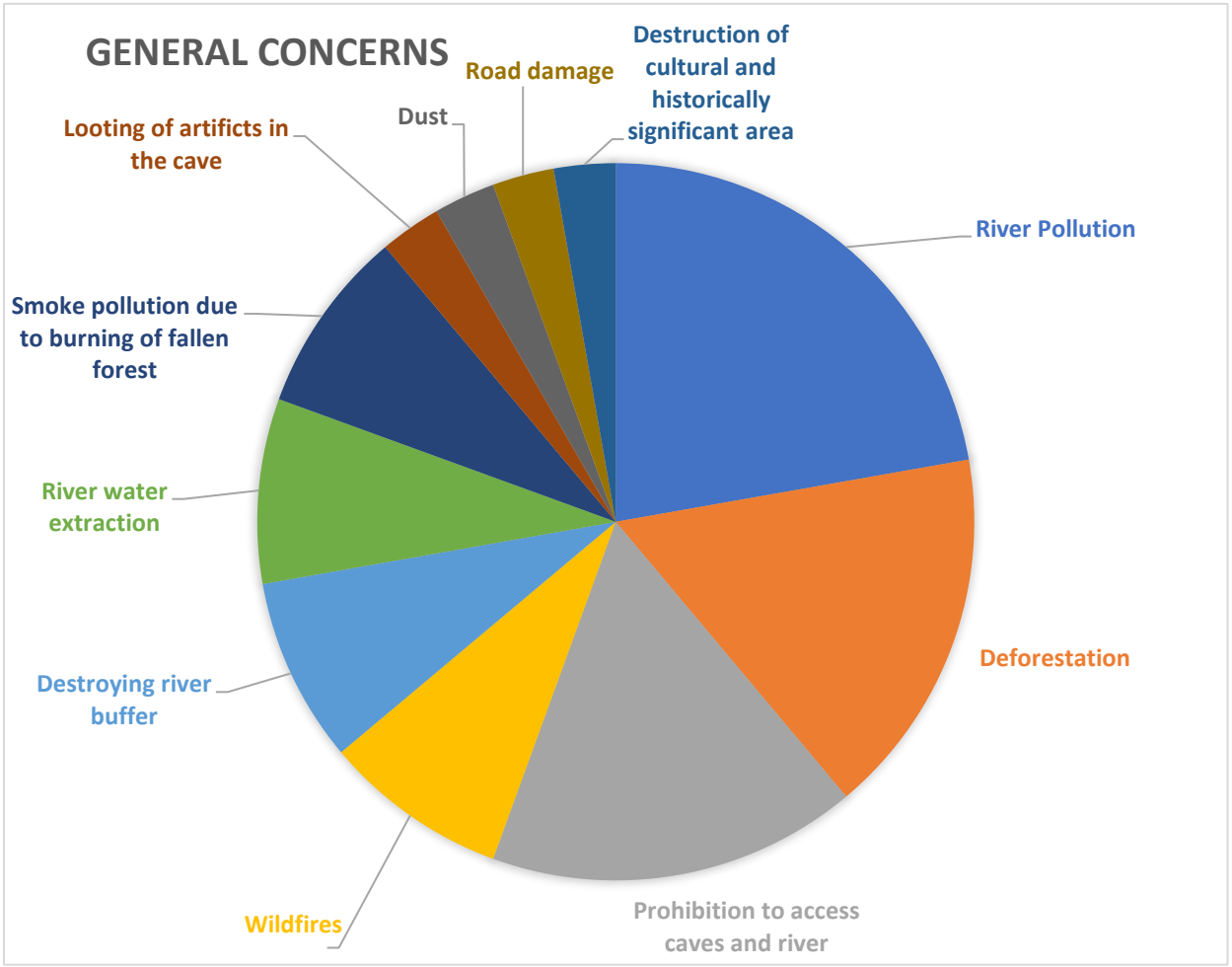


Figure 70: General Concerns with the Proposed Development.

Table 64: General Concerns, Recommended Mitigations, and Summary Statements.

Seven Main Concerns	Recommended Mitigations	Summary Statement
River Pollution.	1. Monthly water quality monitoring. 2. Sustainable agricultural practices. 3. Spray when weather conditions are adequate. 4. Stop using Gramaxone.	Water runoff carrying fertilizer and pesticide residue into the river was explicit and connected to the need for 1) water quality monitoring and 2) responsible use of fertilizers and pesticides.
Deforestation.	1. Leave windbreaks. 2. Leave roadside hedges like Santander for green areas. 3. Implement strict policies related to forest clearing. 4. Increase monitoring to combat uncontrolled wildfires. 5. Build community awareness in fire management.	The barren large tracks of land and the associated loss of habitat were an explicit concern, giving rise to the need for 1) having some forested areas (windbreaks and roadside hedges), 2) prevention of forest loss due to wildfires, and 3) building community awareness in fire prevention and management.
Prohibition to access caves and river.	1. Co-management with GOB oversight. 2. Open public road. 3. Demarcate roads for recreation. 4. Need to provide public access to the river. 5. Survey an area for public use. 6. Demarcate public access.	The prevailing perspective is that restrictions may be imposed on access to the caves (designated conservation areas) and some portions of the river, specifically those portions passing through the property. Mitigations: 1) to establish a co-management of the cave site for its development, conservation, and exploration, and 2) Establish suitable public access road(s) to the caves and river.
River water extraction.	1. Monitoring by compliance agency.	There was a concern that river water abstraction for irrigation purposes during the dry season could exacerbate the river condition. One mitigation proposed was the monitoring of the river level by a competent agency.
Smoke pollution due to burning of fallen forest.	1. Acquire burn permits, notify neighbours, and develop a burn plan.	The general area is prone to seasonal wildfires, and at the time of the survey, there was

		much smoke to be observed in the area. Acquiring burn permits and notifying neighbours who are to be affected are reasonable responsibilities.
Destroying river buffer.	1. Monitoring by compliance agency. 2. Clearly state boundaries and set aside land. 3. Leave buffer zone and reforest areas where the buffer has been damaged. 4. Keep buffer zone. 5. Preserve riparian buffer larger than 66 ft.	There was grave concern that some portions of the riverbank were barren or had been clear smaller than the legal minimum 66 ft. buffer requirement. The buffer need to meet or exceed the legal requirement, 2) restored where necessary, and 3) closely monitored.
Wildfires.	1. Implement different ways (redundancy) to reduce fires. 2. Have wildfire mitigation landscape design. 3. Increase monitoring to combat uncontrolled wildfires. 4. Build community awareness of proper fire management.	The seasonal wildfires in 2024 appear to be the worst in recent years for many and receive critical scrutiny. Establish 1) internal (farm level) prevention and mitigation strategies and 2) build community awareness of proper fire prevention.

10.6.6 Potential Benefits and Recommendation to Strengthen Benefits

The only benefit stated in a couple of instances was food security. There was a general view that the mechanized farming done by the Mennonite farmers was not labour intensive; consequently, no employment for locals would be available. However, at the public consultation meeting in La Democracia Village, the idea was that perhaps the Spanish Lookout Group could support the school feeding program and help maintain the lawns of some village public spaces in support of the buffer communities. No recommendations to strengthen the benefit were made (Figures 71 and 72).

During the data collection period, the village council executives from both Mahogany Heights and La Democracia expressed a desire to meet with members of the development group to hear from them about the project, tour the project zone, and share some of their concerns. On June 22, 2024, the encounter happened, and the ideas exchanged were: 1) The need for the development

to be environmentally friendly, 2) Support the surrounding communities directly and indirectly, 3) Breaking down negative stereotypes, and 4) The operational system of the Spanish Lookout Community Corporation Ltd. The encounter between the parties was candid, cordial, and optimistic.

Figure 71: Village Council Executives (VCE) meet with SLCCL.

Figure 72: L-R: Francis Reimer (SLCCL), Jermain Sanchez, Raquel Trapp, Peter Lewis, Therese Brakeman, Irma Ramos VCE), and Stephen Dyck (SLCCL).

Possible Infringements of Customary Livelihoods within the Project Zone. The four infringements rated as being high, are a priority concern. See Table 65 for details.

Table 65: Possible Infringements of Customary Livelihoods within the Project Zone and Summary Statements.

Rating	# of Responses	Named Infringements	Summary Statement
High	4	1) Prohibition to access traditional fishing and hunting locations. 2) Passing through the property for hunting and fishing. 3) Access to conduct cave tours. 4) Access to the river in customary locations.	Access to the river, hunting grounds, and cave systems are highly rated infringement concerns within the project zone.
High	3	No infringements were named.	
Medium	0	---	
Low	2	Traditional use river locations,	
None	1	---	

Possible Displacements of Customary Livelihoods and Summary Statements. The four stated possible displacements are a priority concern. See Table 66 for details.

Table 66: Possible Displacement of Customary Livelihoods Around the Project Zone and Summary Statements.

Rating	# of Responses	Named Displacements	Summary Statement
High	5	1) Use of the river and hunting grounds. 2) Pollution of the river. 3) Displacement of wildlife. 4) Use of the caves and river to do tours.	Displacement from using the river, use of hunting grounds, and use of caves from customary use are the key highly rated displacements concerns.
High	2	No named displacements.	
Medium	0	---	
Low	1	No named displacement.	
None	2	---	

10.6.7 Identified Health Issues for Residents in and around the project zone

While only a few general health issues were stated, the conditions that could result in adverse health issues were clearly stated: air and water contamination, as reflected in Figure 73.

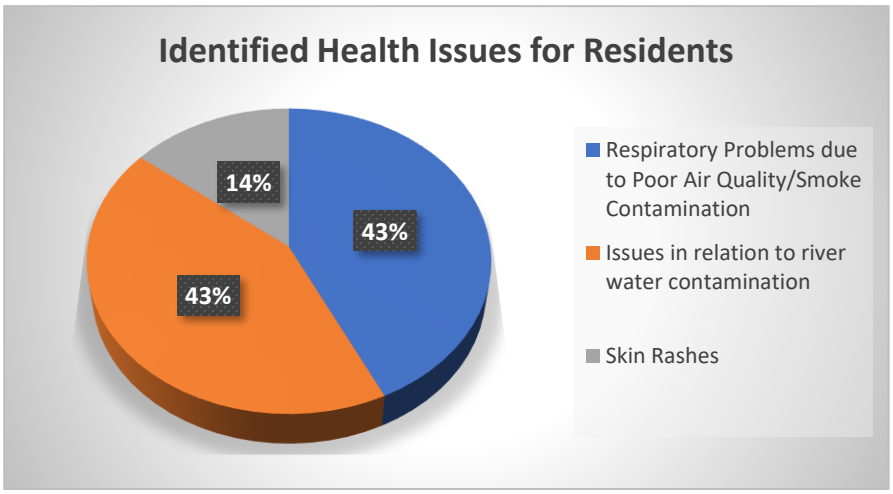


Figure 73: Identified health issues for residents in and around the project area.

10.6.8 Identified safety issues for residents around the project zone

Wildfires were the most frequent safety issue, followed by erosion, flooding, and road traffic accidents (Figure 74).

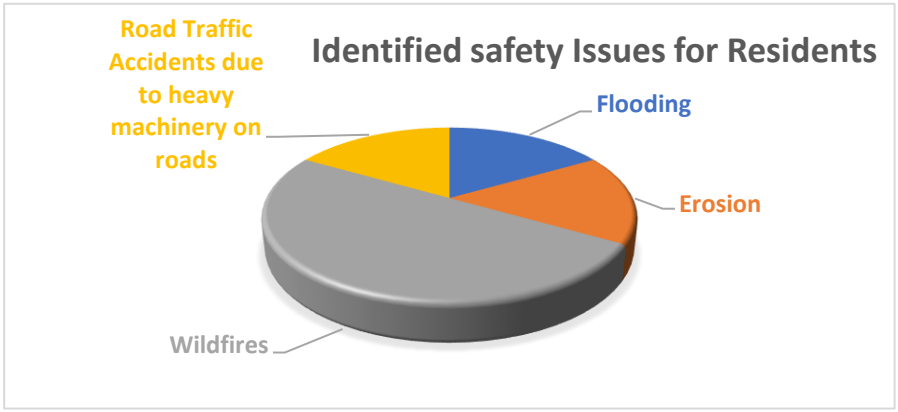


Figure 74: Identified Safety Issues For Residents Around The Project Area.

10.6.9 Identified Health Issues for Workers in and around the project zone

Illness due to exposure to agrochemicals and respiratory problems are the two identified issues (Figure 75).

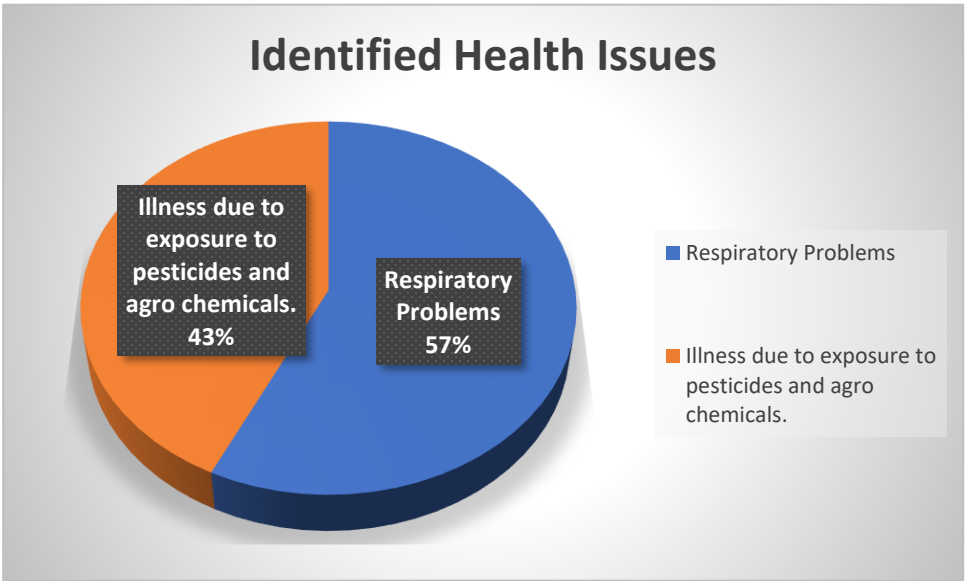

Identified Health Issues
Illness due to exposure to pesticides and agro chemicals. 43%
Respiratory Problems 57%
Respiratory Problems
Illness due to exposure to pesticides and agro chemicals.

Figure 75: Identified Health Issues For Workers In And Around The Project Area.

10.6.10 Identified Safety Issues for Workers in and around the project zone

Hazards inherent in the use of agriculture machinery and heat exhaustion are the only two safety issues for workers (Figure 76).

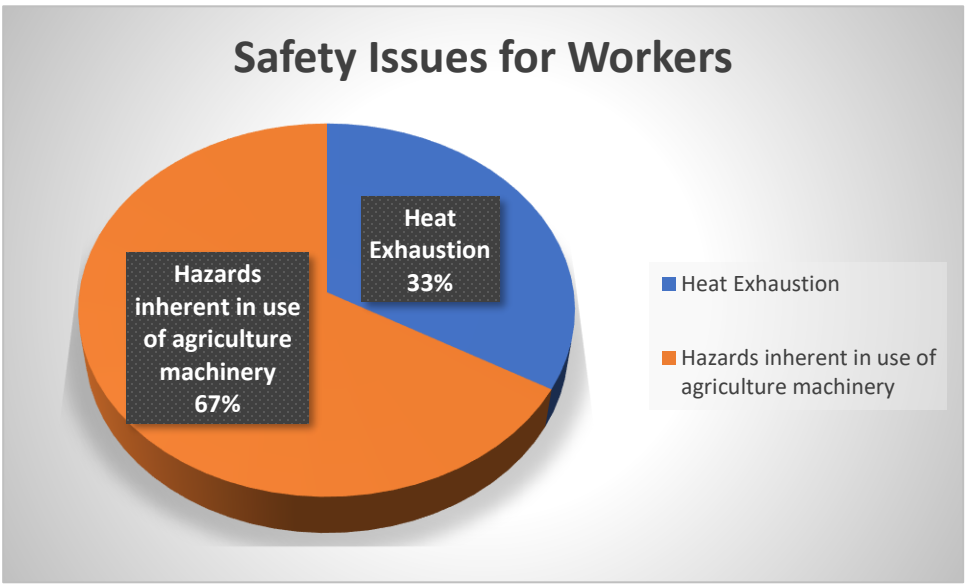

Safety Issues for Workers
Heat Exhaustion 33%
Hazards inherent in use of agriculture machinery 67%
Heat Exhaustion
Hazards inherent in use of agriculture machinery

Figure 76: Safety Issues For Workers In And Around The Project Zone.

10.6.11 Autonomous Information Shared by Responders

Other concerns by responders and possible recommendations and comparison of survey data and meeting data for congruence are shown in Tables 67 and 68, respectively.

Table 67: Other Concerns by Responders and Possible Recommendations.

#	Comments	Possible Recommendation
1	a) Important to protect the Tiger Sandy Bay Cave System.	Establishment of tripartite (Private Sector, NGO, and Public Sector) management of the Tiger Sandy Bay Cave System for the exploration, cataloguing, conservation, and economic generation.
2	a) Important to protect the Sibun River Water Shed System.	DOE to develop a public, private, and community-based mechanism to monitor this watershed.
3	a) Demarcate river sides to identify river buffer zones. b) Regular and routine monitoring by compliance agencies.	Verification of proper and realignment where necessary to legal compliance standards or as otherwise recommended by the EIA Report. Monitoring by DOE.
4	a) Flooding in the village because of land clearing.	The immediate buffer villages are unlikely to be flooded due to land clearing, given the geographic landscape, flow, and location of the river in relation to the two main villages. Perhaps a village like Gracie Rock that is downstream may be affected by flooding. Research on flooding and river levels in the area can be consulted or conducted to better inform and address this concern.
5	a) Relationships with the community can be better.	The village council leadership and the Spanish Lookout Corporation may establish voluntary formal and informal cooperation and social activities.
6	a) Need to establish a baseline on the quality of water (aquifer and river). There is an aquifer that supplies the village with water. b) Need to monitor water quality. c) Test for heavy metals and arsenic	Establish minimum standards to be shared with DOE for record and monitoring.
7	a) The development has not bothered the business.	---
8	a) Seeing a higher concentration of wildlife on our property.	The wildlife is not seen as a nuisance or threat to the people or business.

9	a) This project has been a disaster from day one, and no amount of justification will make it right. This area was designated as a regionally important biological corridor in 2019, and this land use change has compromised it.	Leaving adequate river buffers and strategic patches of vegetation (regrowth and old citrus trees, etc.) and expanding the designated conservation area may provide some valuable shelter and habitat for flora and fauna.

Table 68: Comparison Of Survey Data And Meeting Data For Congruence.

Questions	**Survey Responses**	**Meeting Responses**
1) Name the top customary livelihood activities that occur within the project area.	1) Hunting. 2) Fishing. 3) Caves and river tours. 4) River for recreational use. 5) River for washing clothes.	1) Swimming. 2) Fishing. 3) Tour of caves. 4) Hunting. 5) Protected area.
2) List in priority order the general concerns you have with the proposed developments and recommendations to address concerns.	1) River pollution. 2) Deforestation. 3) Prohibition to access caves and river. 4) River water extraction. 5) Smoke pollution. 6) Destroying river buffer. 7) Wildfires.	1) River pollution. 2) Deforestation. 3) Noise pollution. 4) Dust pollution. 5) Not much employment for the community. 6) The river buffer zone needs to be larger, given the vast agricultural development. 7) Can the initial development plan change, and would this require another EIA?
3) Identify possible infringements.	1) Prohibition to access traditional fishing and hunting locations. 2) Passing through the property for hunting and fishing. 3) Access to conduct cave tours. 4) Access to the river in customary locations.	1) Access to the river. 2) Access to Sandy Bay.

10.7 The Maya Forest Corridor

10.7.1 Background

The Maya Forest Corridor is Belize's most important and most threatened wildlife corridor, as it connects the country's two largest forest blocks: the Maya Mountain Massif in southern Belize and the greater Belize Maya Forest that includes Rio Bravo. The corridor provides connectivity for Belize's National Protected Areas System and regional connectivity to the trinational Selva Maya. Measures that allow for safe road crossings are vital to the long-term survival of Belize's wildlife that is a part of cultural heritage, nature-based tourism, sustenance, and livelihoods.

A consultation meeting request was made via letter dated October 3, 2024, to the Chief Environmental Officer, Mr. Anthony Mai, by the Maya Forest Corridor Coalition to which the EIA Team accommodated.

10.7.2 Consultation and Site Visit

The consultation and site visit were conducted on November 30th, 2024, at the Spanish Lookout Community Corporation Ltd (SLCCL) project site near La Democracia Village, Belize District. The purpose of the consultation was to meet with the NGO community to familiarize themselves with the proposed project, particularly its components to support corridors through the preservation of buffer zones and riparian forests within the property. It was agreed that a brief report on this consultation will be prepared and circulated, as well as included as part of the EIA consultation process.

Present were members of the Members of the Maya Forest Corridor Coalition: Dr. Elma Kay, Belize Maya Forest Trust, Jamal Andrewin-Bohn, The Belize Zoo, Dr. Kayla Hartwell, Runaway Creek (Foundation for Wildlife Conservation), Boris Arevalo, Wildlife Conservation Society and Jake Snaddon, University of Belize. Representing the Development Investors was Francis Reimer and other Spanish Lookout Community Corporation Limited (SLCCL) representatives. The consultation was led by Ismael Fabro, Lead Consultant, supported by Evaristo Avella, Oswaldo Sabido, and Craig Moore.

Mr. Francis Reimer, SLCCL representative, explained the project proposal and proceeded to present a mapped layout of the project area identifying the buffer zones and conservation areas that the project intends to implement (Fig. 77).

10.7.3 Key Findings

1. The buffer zones were considered acceptable with the exception of an area that buffers the adjacent property owned by the Wildlife Conservation Society (WCS) that does not have a corridor linking the Highway area with the adjacent conservation zones to the west. This issue was the main item discussed. The developers informed the group that they had acquired two parcels that had been on the market for some time to add to the development. It was possible for these to be acquired by the NGO community after consultation with the SLCCL shareholders to serve as the connectivity the coalition was seeking. Another option was using these two parcels for conservation and replacing an equal sized parcel from within the existing conservation zone for agriculture purposes. These suggestions would be discussed with shareholders, and a response would be issued. No timeline was set. It was also agreed that the EIA preparers would assist in providing an updated map of the ongoing zoning and layout scheme.

2. A question arose about the size of the riparian zone around the Sibun River within the property. It was clarified by the lead consultant that 150 feet of buzzer zone had been recommended and that, in some areas, there is a larger area adjacent to the river that is being conserved.

3. A request was also made to review the draft EIA before it was made public, to which the company representative explained that he would need authorization to do that since the draft has still not been vetted by the DOE.

4. A recommendation was also made that all stakeholders should pursue further discussion on common issues such as firefighting and the control of illegal activity in the area.

The consultation ended in a positive manner and all agreed to continue the positive dialogue.

Figure 77: Mr. Francis Reimer, SLCCL representative, explaining the project.

CHAPTER 11 RAPID ARCHAEOLOGICAL ASSESSMENT

11.1 Introduction

In April 2023, the Belize Archaeological Services (BAS) was contracted on behalf of Tiger Bay Ltd. to conduct a rapid archaeological analysis of a property in the Belize District. The study area is located 3.5 km (2.25 mi) southwest of Democracia Village. The entire property is composed of 6719 acres.

The property being considered for development lies in an area that has received limited and sporadic research attention. Despite this paucity of research activity, the archaeological data available for this sub-region of central Belize indicates that it witnessed considerable prehistoric activity that extends from Paleoindian 8000 BC times (Stemp et al. 2016) to the early Historic (AD 1600) period (Awe and Helmke 2007, 2015). Limited research in the area further indicates that there may be considerable ancient Maya settlements between Belmopan and the Sibun and Caves Branch watersheds to the south and southeast, in the area west along the Roaring Creek valley, and to the north and east of Belmopan City.

11.2 Project Description

The property encompasses an area of approximately 6719 acres of land once belonging to Tiger Sandy Bay Farms Limited, located near Mile 31 on the George Price Highway and extending near Runaway Creek and the Sibun River along the Coastal Highway in the Belize

The land included three different parcel lots adjacent to each other. The parcels of land were acquired from James and Steven Downard which were the owners of the Tiger Sandy Bay Farms Limited lands. Tiger Sandy Bay Farms had previously cleared much of the land which is currently in grain production by the new owners. Most of the previously cleared area was once under citrus production with many of the trees affected by citrus greening with the orchard appearing abandoned in some areas. The owners had placed the land on the real estate market as they felt they could no longer keep up the operations.

In January of 2022, the Spanish Lookout Community Corporation Ltd (SLCCL) and Tiger Sandy Bay Farms Limited signed an agreement for the purchase of land and the owners began converting most of the previously cleared area, along with some areas under secondary forest cover into grain production. The present status for the use of the land indicates that 2,751 acres or 41 percent of the property in question is already cleared and being used for agriculture, mainly grains (corn, bean sorghum) with just a few citrus trees still left standing.

The present plan also looks at setting aside 1,649 or 25 percent of the land for conservation purposes or for future ecotourism development (Figure 78). The section of this property is also hilly and contains numerous caves with several of them containing Mayan pottery. It borders Monkey Bay Wildlife Sanctuary and is used by them for tour guiding activities in the area. Only 1301 acres or 19 percent presently under natural vegetation is proposed to be cleared for additional agricultural purposes, primarily for the planting of grain crops.

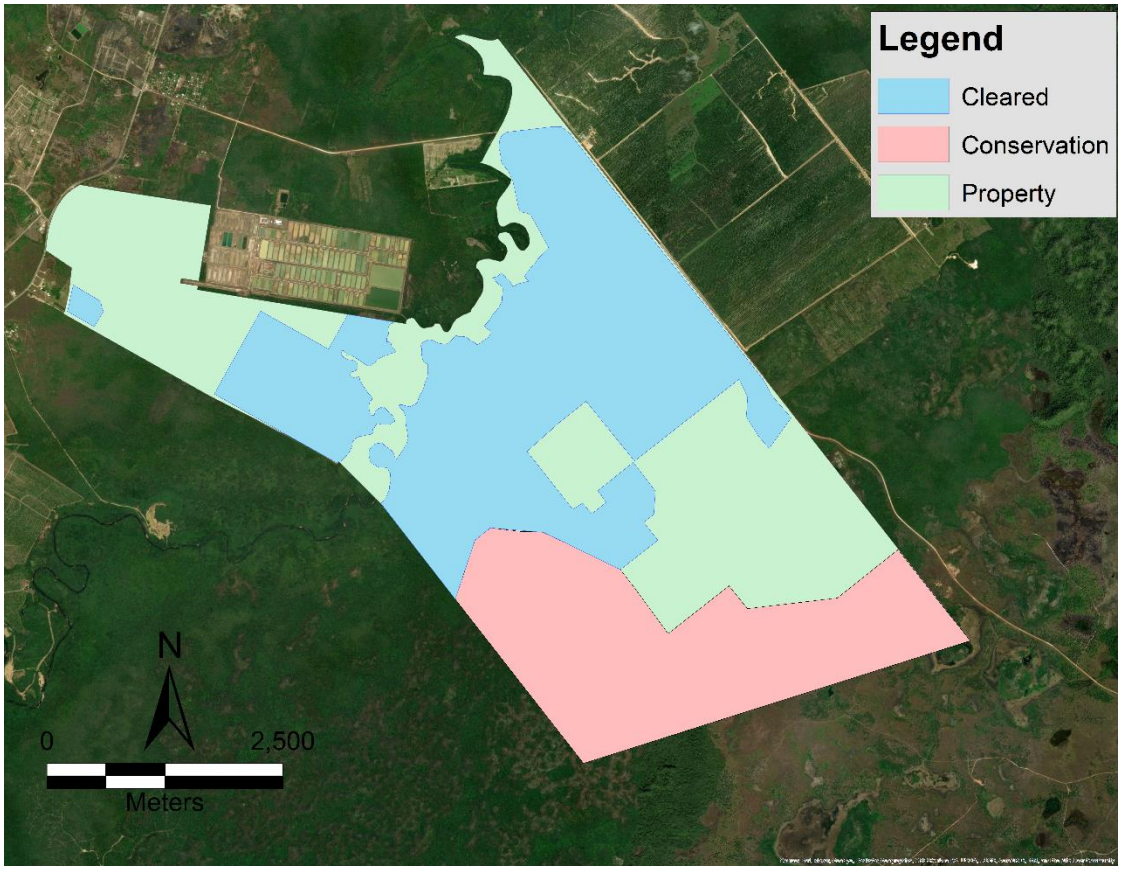


Figure 78: Closeup of the Development Area showing the proposed development areas.

11.3 Research Design

A Rapid Archaeological Assessment (RAA) comprised of a literature review analysis by the Belize Archaeological Services to fulfil requirements related to archaeology in the TOR for an EIA for Tiger Bay Limited was conducted on the property. In addition, field inspection was conducted. Also provided was a Digital Elevation Model of the area, generated from LiDAR data for the area which assisted in the review. The DEM was used to conduct a Topographic Positional Analyses in order to identify anomalies that are often archaeological features on the surface. Since no detailed survey was conducted, the site visits only encompassed visual observation by the author. To complete the literature review, the BAS researched the extant literature available at the Belize Institute of Archaeology and other sources. The results of the survey and assessment are listed below.

11.4 Review of Archaeological Research in East-Central Belize

11.4.1 Brief overview of the prehistory of Belize

As noted above, one of the primary purposes of our survey was to identify any archaeological sites and features of archaeological significance in the property of Tiger Bay Development around the Democracia Village. To provide an archaeological context to the survey, a brief overview of the prehistory of Belize is provided below.

Archaeological sites in Belize generally fall under one of three designated types: Preceramic, Prehistoric Maya, and Historic period settlements.

1. Preceramic sites are subdivided into two categories, Paleoindian and Archaic. The former includes the camp sites of the first human inhabitants of Belize and dates between 12,000 to 8,000 B.C. The 8,000 BC end date of the Paleoindian period coincides with the end of the Pleistocene ice age, during which time many species of animals, like the mastodon, giant sloth, horse, and tropical cave bear, went extinct. The end of the Pleistocene ice age also witnessed changing climatic conditions and led to the establishment of tropical ecosystems across Central America. The subsequent Archaic phase spans the period from 8,000 to 2,000 B.C. This period is marked by changes in human adaptation and led to the development of new stone tool technologies, greater reliance on plant exploitation, and the eventual establishment of

agricultural settlements. Both these preceramic phases also pertain to occupants who culturally are considered pre-Maya inhabitants

2. Prehistoric Maya occupation extends from at least 2,000 B.C. to the time when contact with the first Europeans was made around 1,500 A.D. The earliest Maya settlements, which were established between 1,200 and 900 BC, consisted of small villages inhabited by incipient agriculturalists who began to use pottery. By 700 BC, Maya settlements began to rapidly increase in size and there is evidence for the introduction and construction of monumental architecture. Major sites, with all the trappings of advanced civilization become fully established by 200 BC, and Classic Maya civilization reached its apogee in Belize between the start of the Christian era to about 800 A.D. Between 900 to 1000 AD, Maya civilization began to decline and most of the once thriving cities were abandoned. Much of Belize was subsequently re-occupied during the Late Postclassic period (1,200-1,500 AD).

3. The Historic Period spans from 1,500 to 1,900 A.D. and encompasses the time from Spanish contact to the early phase of British colonial settlement. Spanish incursions or *entradas* to Belize were quite limited and often consisted of Spanish missionaries who were attempting to convert the Maya to Catholicism. Evidence of their missionizing efforts remain in the ruins of a few churches that they built in northern, western, and east-central Belize. The Spanish eventually gave up their efforts to occupy Belize and many of the Maya living in the country were forcibly removed Spanish settlements in Guatemala. When the British move in in the late 17th century, they first began to occupy offshore islands like St. George's Caye, and later move onto the central and northern coastal areas. They eventually moved inland along the major rivers that flow into the Caribbean Sea. With few exceptions, such as Spanish Lookout along the Belize River, and Gallon Jug in Orange Walk, early British activity is therefore most prevalent along the coastal regions of Belize.

11.4.2 Review of archaeological research on east-central Belize

Archaeological research in east-central Belize (Figures 78 and 95) has had a long, but sporadic, history. The geographic coverage of this sporadic research is also quite limited and uneven, with most previous research focusing on areas to the north and south of the Gales Point village and its

immediate periphery. We therefore provide here a summary view of the historic and areal coverage of research in the greater east-central Belize zone.

11.4.3 Archaeological Investigations to the east-central Belize

The first archaeological exploration of east-central Belize was conducted by Thomas Gann in 1929. At that time, Gann explored several cave sites, including Batty's Cave and Sally Pan Cave, both located along the Sibun River valley. In his report, Gann (1929:247) mentioned that the former cave was used by an old gentleman to pen his pigs. At Sally Pan Cave, which Gann (1929:247-248) reported was within a five hour walk from Runaway Creek residents rumoured that it was "the hiding place of a legendary thief" (Peterson 2006:89).

Subsequent reports of archaeological activity in the Sibun River valley date to the early 1970s. These include Michael D. Malone's brief visit to Actun Polbilche in 1971 (Malone 1971), a reconnaissance of Tiger Bay Cave by Carol Jo Rushin-Bell (1982) and members of the Belize Department of Archaeology in 1973, and David Pendergast's (Royal Ontario Museum) investigation of Actun Polbilche in 1972-73. Pendergast (1974) subsequently published an excellent monograph on his work at Actun Polbilche that presents a detailed description of his investigations, plus considerable information on the cultural remains recovered at the site, including several well-preserved wooden artifacts and ceramic vessels. See map of selected archaeological sites of Belize in Figure 79 and Figure 80 map showing the cave districts established in the Sibun River watershed by the Sibun Archaeological Project (after Peterson 2006).

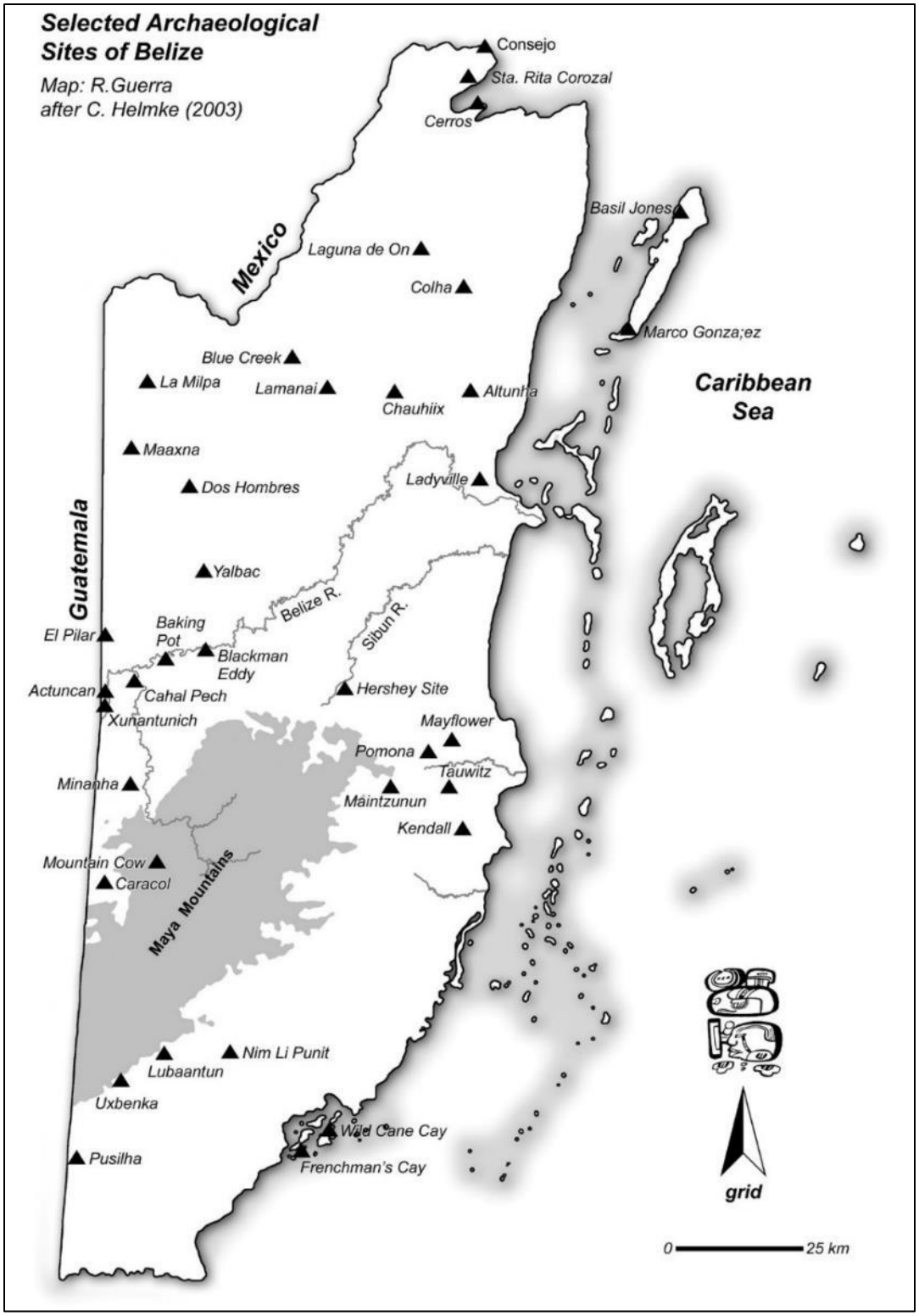


Figure 79: Map of Belize indicating location of some major archaeological sites.

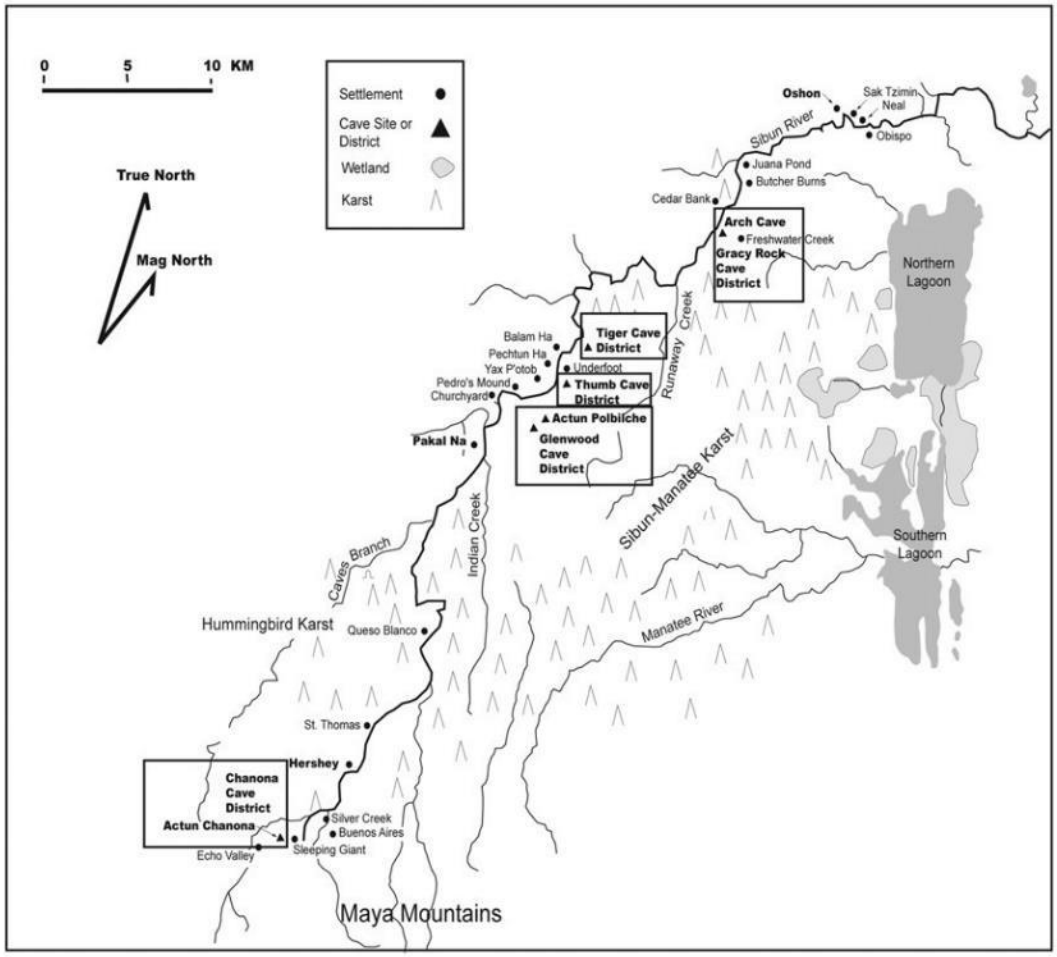


Figure 80: Cave Districts Established in the Sibun River Watershed by the Sibun Archaeological Project (after Peterson 2006).

Between 1976 and 1979, Tom Miller (1981), then a graduate student at McMaster University in Canada, conducted doctoral research on the karst hydrology and morphology of the Caves Branch area. During his investigations, Miller, who focused primary attention on the headwaters of both the Caves Branch and Sibun Rivers, discovered several new cave sites which he reported to the then Belize Department of Archaeology. Several of the sites (e.g., Waterfall Cave and Footprint Cave) were later visited and recorded by Jaime Awe, who was Archaeological Assistant to Joseph Palacio in the Department of Archaeology.

In 1978, Barbara MacLeod and Dorie Reents returned to the area and co-directed the Petroglyph Cave and Caves Branch Valley Projects (MacLeod 1974, 1978; MacLeod and Puleston 1978; Reents 1980a, 1980b, 1997; Reents and MacLeod 1986). Their work in Caves Branch Cave, and

especially in Petroglyph Cave, recorded considerable evidence for ancient Maya cave rituals, architectural modifications, and ancient Maya cave art. A couple of years later, Elizabeth Graham, then acting Archaeological Commissioner for Belize, organized excavations in Actun Chek in 1979 (Graham, McNatt and Gutchen 1980; McNatt 1995). In their report, Graham et al. (1980) also described preliminary investigations of Chanona Cave which is located west of the Hummingbird Highway.

Several years later, in 1986, Elliot Abrams conducted a survey of a small settlement known as Balam Ha near Tiger Sandy Bay (Abrams 1987:7). During his brief work at this Sibun valley site, Abrams recovered several pot sherds, and he recorded a ceramic bowl that had been collected from Tiger Cave by landowner David Downard. Abrams's research at Balam Ha, indicates that this is the closest site to the Tiger Bay area at 1.73 km west of Tiger Bay Cave district (Petterson 1987). Abrams' investigations were followed by explorations of cave sites in the Gracy Rock area by a speleological expedition out of Queen Mary College from the University of London, England. The Queen Mary College exploration reconnoitred and mapped four caves – Cedar Bank Cave, Gibnut Cave, Gracy Rock Hill Cave and Gracy Point Cave – which were later reported in a publication edited by Marochov and Williams (1992).

Archaeological investigations along the Sibun drainage were restarted in the mid-1990s. This new research was initially directed by Juan Luis Bonor Villarejo, a cave archaeologist from Spain, who, along with Carolina Martinez Klemm, were working for the Belize Department of Archaeology. Bonor Villarejo and Martinez Klemm (Bonor Villarejo 1994, 1995; Bonor Villarejo and Martinez Klemm 1995) spent two seasons conducting salvage excavations in Caves Branch Rockshelter, and they recorded several other cave sites in the vicinity of Ian Andersons Jungle Lodge.

By far, the most comprehensive archaeological research in the Sibun River watershed is that conducted by Patricia McAnany's Xibun Archaeological Research Project (XARP). Operating under the auspices of Boston University, McAnany's project began research in the area in 1997 and continued into 2004. During this extensive period, McAnany and her students (McAnany 1998, 2002; McAnany et al. 2002, 2004; McAnany and 2003; Morandi 2010; Peterson 2006; Thomas 2005) recorded and investigated twenty-two prehistoric settlements and seventeen cave

sites. In her Ph.D. dissertation, Peterson (2006), a student of McAnany, subdivided the watershed into 5 Cave Districts or subregions (see Figure. 4). From west to east, these included the Chanona Cave District, the Glenwood Cave District, the Thump Cave District, the Tiger Cave District, and the Gracy Rock Cave District. The Glenwood Cave District overlaps with the Paumen property which is presently home to a tourist destination known as "Dark Night Cave Tubing Adventures" (see below). Peterson's (2006: ix) research also noted that almost all the settlements recorded in the Sibun watershed are located within a kilometre from a cave and that they "revealed patterns of ritual utilization spanning the period from the Middle Formative to the Spanish Colonial period (1000 BC–AD 1798)." Peterson (2006: ix) further notes that the "Large caves were appropriated by elite members of the society while small caves and rock shelters appear to have been used by the general populace."

Following Bonor Villlarejo's departure from the Belize Department of Archaeology, and the end of McAnany's Xibun Archaeological Project, the Western Belize Regional Cave Project, under the direction of Jaime Awe, renewed investigations of the Caves Branch area in 2006. This included further investigations of the Caves Branch Rock shelter (see Wrobel 2008; Wrobel and Tyler 2006; Wrobel et al. 2007) and the recording of new sites further downstream. A couple of years later, Wrobel established his own research project known as the Central Belize Archaeological Survey (CBAS). The latter continues to operate, with special focus on the area between the Caves Branch and Sibun Rivers, and along the headwaters of the Roaring Creek (see Wrobel et al 2009, 2013).

Other research, specifically focusing on sites within the property of Brad Paumen, was recently conducted by the Belize Research Cave Project (BRCP) under the direction of Holley Moyes (University of California Merced) and Jaime Awe (Northern Arizona University). Starting in 2015, this project investigated several sites that were previously reconnoitred by Jaime Awe, Rafael Guerra, and other members of the Belize Institute of Archaeology. During two seasons of research, the BRCP recorded nineteen caves and rock shelters. Some of the caves, such as Long Cave and Daylight Cave, are of considerable size and all of them contain evidence of prehistoric Maya activity. Two cave sites in the Paumen property also contained evidence of Preceramic use, including a Lowe point. Other cave sites in the region contain rock art in the form of handprints,

painted geometric designs, and petroglyphs. Many of the sites in this area also have evidence of previous looting activity, but some sites appear to be relatively pristine.

11.5 Field Observations

On April 25th, 2024, the senior author joined the EIA team of consultants for a site visit at the Tiger Bay property. The visit was to determine the terrain and coverage of the property. During the site visit a drive over of the currently cleared land was conducted and a short visit to the area deemed for conservation. Within the area deemed for conservation several caves were visited, including one cave that was used by the Fosters for filming and Tiger Cave (Peterson 2006) (Figure 81). Several other unnamed caves were also visited on this trip (Figure 82).

Figure 81: Fosters for filming and Tiger Cave (Peterson 2006).

Figure 82: Entrances to Caves.

11.5.1 Caves

In the cave used by the Fosters, there was a fenced in area with a tapir skeleton as was identified by Petterson (2006). Several ceramic sherds and a large quantity of Jute shells were identified on the surface of the cave (Figure 83).

Figure 83: Tapir Skeleton & Ceramic Sherds.

In Tiger cave several vessels were identified in a small alcove about six (6) meters above the ground level (Figure 84). The owners of the property indicated that Monkey Bay Wildlife Sanctuary frequently use the cave and placed a ladder to access the upper alcove. All the vessels are Late Classic to Terminal Classic and include Sibun Redneck Jar fragments and a single, broken Daylight Orange bowl.

Figure 84: Ceramic Pots.

The other caves visited had cultural materials including ceramic fragments and Jute shells. While no artificial constructions were noted in these caves, Petterson (2006), indicated that several caves in the area had been recorded with man-made modifications.

11.5.2 Drive through observations

On the drive to the conservation area, we had to drive through already cleared fields that were in the process of being ploughed for agricultural use. The ploughing allowed for extensive linear observation on the property. No surface archaeological remains were visible.

Since no archaeological survey permit was requested for this visit, the information provided is solely based on a drive through surface observation. The ploughing of the fields at the time provided ample linear clearing to indicate that in the cleared area there are no observable surface archaeological features.

11.6 Topographic Positional Index Analyses

The Topographic Position Index (TPI) was used to identify archaeological features (referred to as "possible" mounds) based on the lidar dataset. TPI analysis produces a raster with cell values reflecting the difference between elevations in a particular cell and the average elevation of cells within a specified search radius (Jenness, 2006; Weiss, 2001).

Positive TPI values indicate that the cell is higher and steeper on average than neighbouring cells, and significantly high values suggest the cell represents a high point within a specified search radius (i.e., hilltop). When considered at the local scale, features such as mounds represented by higher TPI values (Awe et al., 2015; Ebert et al., 2016).

TPI analyses were performed in ArcGIS 10.3 using the generalized TPI methods. An annular search area was used to classify slope position, where cells within 2 m and 10 m from the sample points were considered in calculations (Ebert et al., 2016). The resulting TPI raster was classified based on standard deviations from the elevation, reflecting the variability of elevation within each sample block (Weiss, 2001). Cells with the highest values represented features on the ground surface that resembled archaeological structures (Awe et al., 2015).

No possible mounds were identified in the study area, suggesting that there are no surface archaeological remains large enough to be identified through LiDAR analyses (Figure 85).

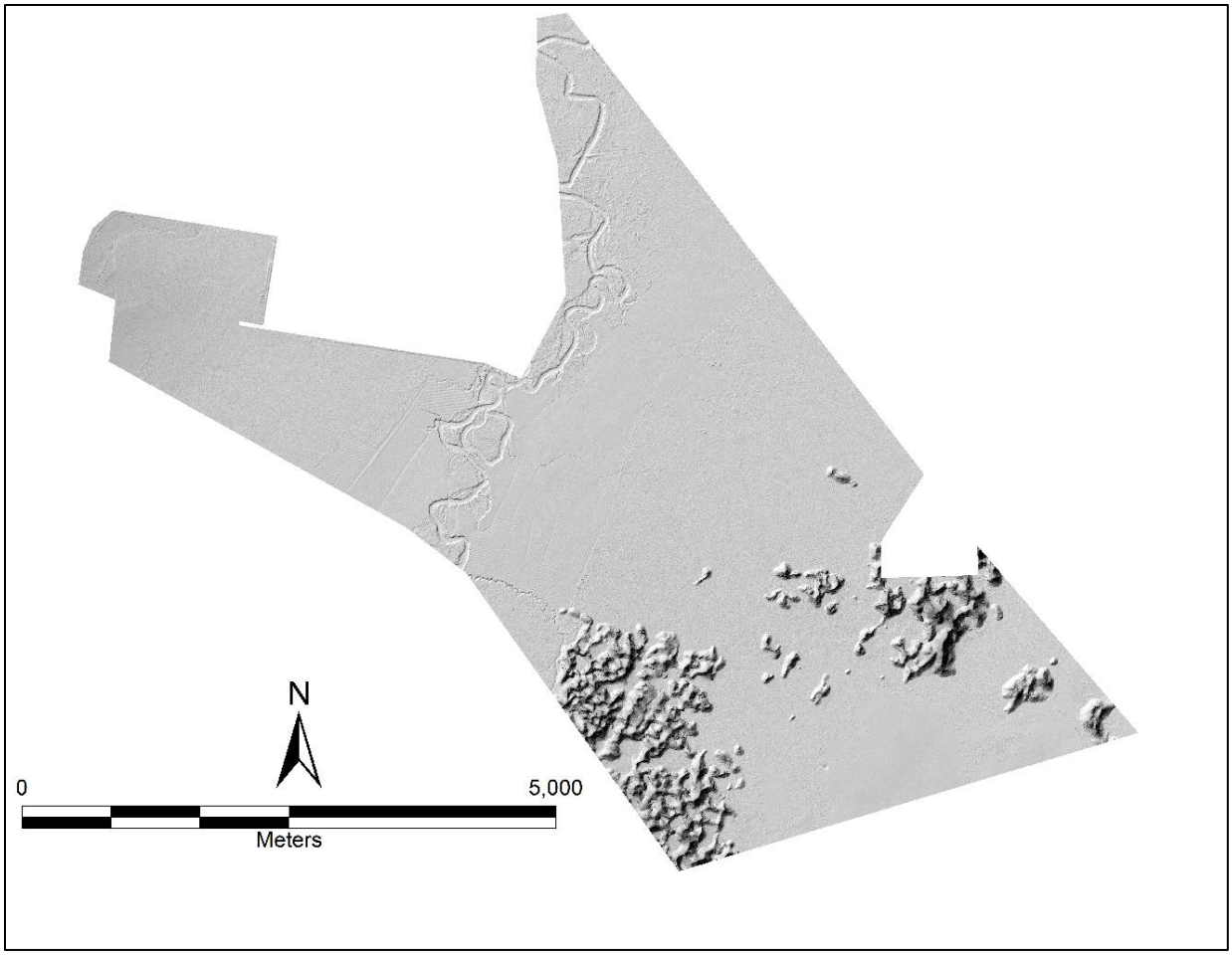


Figure 85: Map of Project Area Topographic Positional Index analysis.

11.7 Conclusion and Recommendations

The purpose of this RAA was to determine whether there are known archaeological sites that would be impacted by planned development in a property that is located to the south of Democracia Village in the Cayo District of Belize. As our review indicates, there has been little archaeological research conducted within the confines of the property under consideration. To the east, few surface sites are presently known, but this area contains numerous caves sites such as those at Tiger Cave, Painted Cave and others in the Runaway Creek Reserve. Given the presence of all these sites in the area encircling the property slated for development, it would not be surprising to find that the latter contains evidence for ancient Maya occupation, possibly in the form of rock shelters or caves that are part of settlements associated with a larger yet to be discovered center most likely in the areas set aside for conservation and mining activities. Although no surface archaeological features were identified on this trip, Petterson (2006) indicates that there was a site

nearby that was bulldozed before 1987. A more detailed ground survey of the property could ultimately determine the accuracy of this observation.

Any new development of the area therefore needs to be mindful of this archaeological heritage and should meet all requirements of the Institute of Archaeology as prescribed in the NICH Act as it relates to construction and operation of developments. Failure to meet requirements prescribed by law may lead to the destruction of features of archaeological significance and would be in contravention of the NICH Act. It is recommended that at the time of land clearance that if any archaeological artifacts or presence are revealed that the activity be suspended until the Institute of Archaeology are informed and are able to determine what additional steps would need to be followed.

CHAPTER 12 CLIMATE CHANGE ADAPTATION & EMERGENCY MANAGEMENT

12.1 Climate Change Issues

Human-induced climate change is already exacerbating many weather and climate extremes in every region of the world. Evidence of observed changes in extremes such as intense heatwaves, heavy precipitation, droughts, and increased frequency of major hurricane formation in hurricane basins around the world, and particularly their attributions to human influence, has become more evident since the Assessment Report 5 (AR5) of 2013 (IPCC AR6 WGI-SPM, 2021). Heatwaves, floods, droughts, wildfires and rapidly intensifying tropical cyclones caused misery and mayhem, upending every-day life for millions and inflicting many billions of dollars in economic losses (WMO, 2024).

Regional climate models are projecting a 2-4 °C rise in average surface temperature for Belize by 2050-2080 (NCCO-NAP, 2019). A summary of the model projections for average surface temperature indicates, rainfall could decrease by 20-30% by 2050 and as much as 50- 60 percent by 2080 and sea level rise for Belize would increase by 0.32 -0,63 meters by 2080. The consequences of a 1.5 °C rise in average surface temperatures above the pre-industrial value compared with a 2.0 °C rise is significant, especially for small island and coastal states in the Caribbean region.

The period from 1980 through to 1995 saw a lull in tropical cyclone activity in the western Caribbean, thereafter the region experienced an upsurge in tropical storms and hurricanes through to 2021. The upsurge of extreme hydro-meteorological and related events exposed the vulnerability of the Belize's productive sector, infra-structure and the environment to the destructive effects of extreme weather. These events ranged from extensive floods and beach erosion associated with the threat of hurricane Mitch in 1998, to widespread and devastating floods associated with tropical depression 16 of October 2008 that affected almost a third of the country's population that resides and works in the Greater Belize River Basin and the Sibun River watershed, to the droughts and heat waves of 2000-2003, 2019 and 2024, the Southern Bark Beatle infestation that result in a die back of almost 70 percent of Pine forest stands in the Mountain Pine Ridge and the Southern Coastal Pine forests over the three-year period of 2001 – 2003, and Cat I hurricane

Richard which ploughed through central Belize in October, 2010, and the floods of November 2020 generated by Hurricane Eta and Iota as they moved inland over northern Central America. The SLCCL owners of the property, in particular the individual farm owners will need to be aware of these projected possible impacts of Climate Change and to take measures to adapt to these changes. Mitigation of climate change impacts will need to focus more on the prevention of burning of material and in assisting to prevent and suppress bush fires which are common during the dry season.

12.1.1 Hurricanes

The project area was impacted by Hurricane Keith of September – October 2000, Hurricane Richard of October 2010, and Hurricane Earl of August 2016. November and December 2020 saw significant flooding in the Belize River Basin and the Sibun River watershed generated by landfalling Cat V Hurricane Eta and Cat IV Hurricane Iota along the northern coast of Nicaragua and eastern Honduras. On November 2, 2022, Category I Hurricane Lisa came onshore over the southern coast of the Belize District, generating intense but short periods of thunderstorms and dangerous winds, as far inland as western Cayo and Orange Walk Districts. Hurricanes are predicted to become more frequent and more intense. The project management Team will need to ensure that they have their hurricane preparedness response plan updated and well disseminated among all farmers so that they can adequately respond in a collective manner to these threats.

12.1.2 Floods

Extreme flood events in Belize are generated mostly by tropical disturbances and hurricanes during the rainy season. Floods and extensive inundations are also produced by late season tropical cyclones and cold airmass incursions through Belize during the cool, transition period. Major recorded floods in the Sibun River were the September 1998 flood, and the June 2002 flood event in northeastern Cayo District, which undermined the Beaver Dam Bridge, and caused significant losses in agriculture along the Sibun River. The approach at the Caves Branch and Sibun River bridges were totally submerged during the June 2002 torrential rainfall event. The flood prone zones in SLCCL farming development are in floodplain of the Sibun River and channels of ephemeral streams that drain runoff into the Sibun River.

12.1.3 Droughts

The meteorological records of Belize since the mid-20th century, show that intense, short and extended drought events have affected Belize, impacting the agriculture sector severely. The consensus is that Global Warming will result in more frequent and intense drought events over many regions of the world, including Central America and the Caribbean (IPCC AR-5, 2014).
Future drought events will continue to impact all rainfed agriculture production systems, livestock, and groundwater and surface water resources directly or indirectly in Belize. Cost effective and sustainable adaptation measures are therefore critical to reduce the impacts of future droughts. Drought early warning and water conservation in the operation of irrigation systems are two measures that can be implemented to reduce the impacts of extended drought events in crop production.

12.1.4 Bush Fires

Natural or anthropogenic bush fires are a common phenomenon in the region and Belize during the height of the dry season. Fire incidence tends to be higher during long and intense dry seasons (drought conditions) and when the fuel load becomes plentiful.

A secondary impact of hurricanes in Belize have been wildfires during the dry season following land-falling tropical cyclones, as was the case with the bush fires of 2011 that burned hundreds of acres of forest in the Valley of Peace area of northern Cayo District. A lot of the fuel was uprooted trees and forest dieback that were left scattered over a wide swath, marking the track of Hurricane Richard through central Belize the year before (see Figures 85 and 86). Forest fires can also occur when a large area of forest is cleared and the subsequent felled and dry vegetation is left unattended, therefore providing combustible material for a fire to occur. Less fire outbreaks were noted in the mid reaches of the Sibun River Watershed. However, with drier and longer dry spells, the area will become more prone to bush fires.

In addition, disturbed areas which are colonized by grass are easier to ignite because they contain less water than denser material such as branches and trunks (NWCG Guide 2004). Also, abandoned logging roads overgrown by vegetation may act as fire corridors. The ignition source

is usually electrical storms or man-induced fires (i.e., arson, unattended fires and milpa farming, discarded cigarettes, sparks from equipment, and power line arcs).

Dense forests around and in some localities inside farms usually provide more shade, resulting in lower ambient temperatures and higher humidity, and are therefore less susceptible to wildfires (Graham et al. 2004).

An effective measure to reduce losses caused by bush fires is to have wide and well-maintained fire passes around sensitive crops, farmland and forested areas. A Bush Fire Plan should be prepared and shared with workers who will be part of the firefighting team. Firefighting equipment should be procured and made available for future bush fire emergencies.

12.2 Emergency Management

The main natural hazards facing the SLCCL farming development are, tropical cyclones and hurricanes, localized floods, drought, heat waves, and bush fires, all of which are being drastically affected by Global Climate Change. Possible manmade disasters are those associated with fuel and oil pollution as well as water pollution due to high concentration of suspended solids in water runoff from cultivated fields. Soil infertility and loss of topsoil due to mass wasting agents such as wind, water and solar energy.

Emergency Management is the discipline dealing with and avoiding/mitigating risks. It is a discipline that involves improving capacity and preparing for hazards, supporting, and rebuilding when natural or manmade disasters occur or is over. The actions (efforts to avoid or ameliorate the impacts) taken depend in part on the perceptions of the risk and the measures taken to address and prevent the perceived risks.

12.2.1 Tropical Cyclones

Tropical cyclones are classified into three categories, namely: a) tropical depressions with one-minute, maximum sustained wind speed ≤ 38 m/h (61 km/h); b) tropical storms with maximum sustained wind speeds in the range of 40 – 75 mi/h (64-120 km/h) and c) hurricanes with sustained wind speeds of 75 mi/h (120 km/h) or greater. The speed of maximum winds near the center of the cyclone has been estimated at more than 200 mi/h (320 km/h) in well-developed hurricanes.

Hurricane Richard (October 2010) damaged the secondary forest area of northern Cayo District and south-western Belize District. Hurricane Richard demolished a large swath of primary forest resulting in hundreds of acres of dieback. Figures 86 and 87 provide pictures of damage to forested areas north and east of Valley of Peace Village caused by the track of hurricane Richard through the area in 2010.

Figure 86: A view of the damage to the forest in the Valley of Peace area caused by hurricane Richard, October 2010.

Figure 87: Another view of the damage to the forest in the Valley of Peace area caused by hurricane Richard, October 2010.

12.2.2 Flooding

Although hurricanes are often accompanied by heavy rains, severe rainfall events resulting in flooding are also frequently associated with troughs and tropical depressions. The risk of flooding is therefore not restricted to, nor more likely to occur, during hurricane events. Generally, lower lying areas will be more susceptible to flooding than higher and sloping ground. The damage caused by flooding depends on the type and elevation of facilities in the location. The results of flooding may range from the inconvenience of temporarily submerged work areas and impassable feeder roads to the loss of equipment and consequential disruption of construction activities. As indicated earlier, the SLCCL development is prone to annual floods in the low lying, stream channel areas.

12.2.3 Bush Fires

As stated earlier, the secondary impacts of hurricanes have been wildfires during the dry season following land-falling tropical cyclones, as was the case with recent bush fires of 2011 that burned hundreds of acres of forest in the Valley of Peace area and mid-reaches of the Sibun River watershed of northern and northeastern Cayo District. Forest fires can also occur when a large area of forest is cleared and the subsequent felled and dry vegetation is left unattended, therefore providing combustible material or fuel for a fire to occur.

In addition, disturbed areas which are colonized by grass are easier to ignite because they contain less water than denser material such as branches and trunks (NWCG Guide 2004). Also abandoned logging roads overgrown by vegetation may act as fire corridors. The ignition source is usually electrical storms or man-made (i.e., arson, discarded cigarettes, sparks from equipment, and power line arcs).

It should be noted that dense forests usually provide more shade, resulting in lower ambient temperatures and higher humidity, and are therefore less susceptible to wildfires (Graham et al. 2004). The SLCCL development area is prone to seasonal bush fires, particularly the savannah landscape area of the project zone.

12.3 Emergency Management Plans

12.3.1 Introduction

To reduce the risks associated with the potential impacts of Climate Change and related disasters including manmade disasters in the Mile 33 project zone, the project proprietors will implement its Emergency Management Plan (EMP) aimed at identifying the different potential risks that could impact the development. This plan focuses on seven (7) potential types of risks that can arise from various sources and affect the operation and success or sustainability of the project in some form or fashion. Table 69 outlines some of the more likely risks that could impact farm operations at the SLCCL farming area.

As with any plan it will be reviewed yearly to ensure they remain relevant and effective. These actions supported by other measures will assist to mitigate and ameliorate any negative effects these types of risks could have on the operation, and environment.

Table 69: Summary of the Disaster Preparedness Plan for SLCCL Faming Development.

Risks		Description	Mitigation Measures	Response Stages
1	Hurricanes and tropical storms	Hurricanes and tropical storms can vary in strength and intensity and cause severe damage to the project's infrastructure thus affecting the sustainability of the project.	Maintain a Hurricane Preparedness Plan for the sub-division development. Secure proper insurance coverage where applicable.	Alert, Response, Damage Assessment, and Recovery.
2	Flooding	Flash flooding and prolonged flooding can occur in the alluvial planes and lowlands (bajos)	Improve drainage and access roads in the project zone. Liaise with NEMO	Alert, Response, Damage Assessment, and Recovery.
3	Fire	Ensure fire prevention and mitigation from human carelessness and accidents or electrical shortages. Fire outbreaks can vary in size and can cause irreparable damage to the forest or project's infrastructure. Ensure that all electrical work follows approved installation standards. Conduct routine wiring inspections.	Prepare a Fire Prevention and Response Plan which among other things includes firefighting equipment. Conduct fire drills at least two times per year. Have an updated list of emergency telephone numbers.	Planning, Fire Drills, Fire Suppression Response, Damage Assessment.
4	Fuel/Oil Spills and Leaks	This incident could pose a serious impact to the environment in which the project is found, and also to residence and road users.	An Oil Spill Contingency Plan will be prepared, and personnel trained in oil spill response. All petroleum products will be stored in bunded areas and oil absorbent pads made readily available.	Report and Response, Clean-up/Recovery Damage Assessment.
5	Medical emergency associated with accidents.	Medical emergencies can occur at any moment without giving notice and therefore require a quick and coordinated effort to respond to this need.	A Medical/Emergency Plan (Communication, Transportation and Evacuation) will be executed. First Aid Kit Ensure that SLCCL has certified first aider(s) to assist in this endeavour during field operations	Planning, Response, Report.

12.3.2 Emergency Management Structure and Communication Plan

The prevention of natural or man-made disasters and the emergency response to identified hazards and risks require the collective effort of every stakeholder. It is only through team effort that disasters can be averted and effective plans prepared and implemented.

The farm management of the SLCCL operations will nominate the Operations Manager to address any of the aforementioned risks in accordance with specific Emergency Response Plans that will be developed with the involvement of all employees. In addition, the Operations Manager will conduct periodic "information sessions" to ensure that all stakeholders, especially those recently employed or involved in project related activities, are familiar with the various plans, and their roles in the implementation of the plans.

Developing a detailed communication plan and determining a meeting area are important for the safety of employees during and after an emergency. Therefore, a Farm Disaster Preparedness Plan will have a Communication Plan component in it.

A communication plan ensures that supervisors will be able to communicate with the employees in an emergency. It will also include steps on how to communicate with their families. In addition to the Emergency Services Numbers in Table 70, ensure that emergency contact information is on file for employees and individual farm owners. This information should include contact information for the employees of the project administration.

In addition to a communications plan, ensure that employees all know where to meet when there is an emergency.

- Do not leave the security of an area to go to the meeting or mustering point if there are advisories to stay where you are.
- Make sure the muster point is accessible to all employees.

Table 70: Emergency Services Numbers, SLCCL Farming Development.

Institution	Contact Number	Other Contacts
Western Regional Hospital, Belmopan	822-2263, 822-2264	
San Ignacio Hospital	824-2761, 824-3129, 824-2122	
La Loma Luz Hospital	824-2087	
Karl Heusner Memorial Hospital	223-1548, 5686, 5689, 5691	
Belize Medical Associates	223-0303 or 223-0304	
Universal Health Partners	2237-7870,7873	
Spanish Lookout Ambulance Service	600-0911	
Belize Police Head Quarters Belmopan	911 or 822-2222	
San Ignacio/Santa Elena Police	804-2022	
Belmopan City Fire Service	802-2311	
Belize National Fire Service	90 or 227-2579	
San Ignacio/Santa Elena Fire Service	824-2095/824-4208	
Medical Emergencies	824-2066, 824-2761	
Astrum Helicopters	222-5100	
NEMO Headquarters - Belmopan	936 or 822-2054/822-0995	
DEMO Cayo	824-2022	
Department of the Environment	822-2816 or 822-2542	

12.3.3 Hurricane Preparedness Plan

12.3.3.1. Potential Impacts of Hurricanes and Mitigation Measures

Tropical storms and hurricanes are the most common natural phenomenon affecting Belize and one most likely to impact the Spanish Lookout Community Corporation farming development. Damages resulting from hurricanes will be those primarily associated with strong wind and flooding. Strong wind and flooding on the development site can have several negative effects, the destruction of crops and forest as well as structural damages (due to wind and falling trees or debris) and water damage to feeder roads, culverts, and farm equipment.

To mitigate against flash floods, the natural flow of the Sibun River and Runaway Creek will not be obstructed as far as possible and where there is blockage by fallen vegetation of sediment, the area will be cleared for easy flow of water. Wherever possible the siting of any equipment will be done at the highest elevation point possible in the general project development area. Flooding from the Sibun River will not likely affect the higher agricultural parcels.

13.3.3.2 SLCCL Development of Hurricane Preparedness Plan

The SLCCL Farming Development hurricane preparedness plan will involve planning, alert, response, damage assessment, and recovery stage to deal with any natural disaster involving hurricanes, storms, or tropical depressions. The hurricane preparedness plan will focus on protecting the lives of its employees and on protecting the assets of the company. The plan will focus in securing the existing facilities and the safety of all employees. An important element of the plan is its recovery program to ensure that the farming site is safe and operational at the earliest time possible.

For this plan to be effective the Operations Manager is required to review the plan every year prior to the beginning of the Hurricane Season. There will also be simulation exercises in relation to various elements of the plan.

The hurricane preparedness plan and any of its components does not supersede any plan which the National Emergency Management Organization (NEMO) or District Emergency Management Organization (DEMO) may have for the area but is intended to support and strengthen this national effort to protect human lives and property.

12.3.3.3 Information System

The official information channel is the National Meteorological Service and NEMO. In theory the "official alert" system for a storm or hurricane entails the coordination between DEMO/NEMO, the Belize National Meteorological Service (NMS) and the Operations Manager.

The employees will be provided with information on the description of the hurricane flag signals used during a hurricane (see Figure 88).

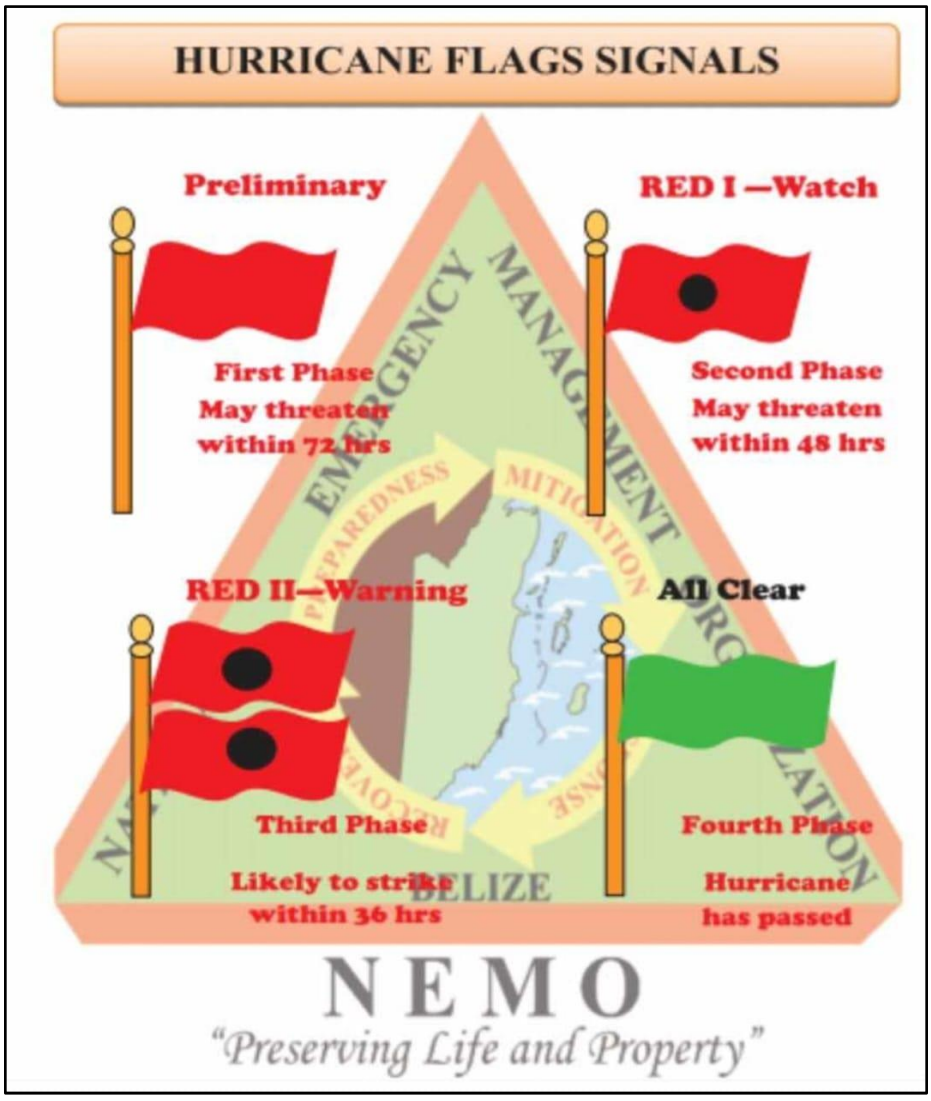


Figure 88: NEMO's Official Hurricane Alert System.

12.3.3.4 Pre-Hurricane Season Preparation

1. At the beginning of May each year the Operations Manager will review the hurricane preparedness plan and update contact/emergency numbers.
2. During the review the roles of individual employees will be clearly defined in a roster.
3. All the required hurricane items are available and properly maintained ready for use.
4. An inventory of all property assets and their condition will be updated.
5. Hurricane tracking charts and current NEMO Hurricane Emergency Plan will be acquired as needed

6. Communication contact will be activated.
7. A review of all assets will be conducted and 'Safe Sites' will be identified and prepared.

12.3.3.5 Preliminary Alert - Hurricane Watch –Red Flag

1. The Operations Manager will advise all employees of a hurricane watch and ask them to stay alert.
2. Service Vehicles or farm equipment are maintained full of fuel and ready to be moved to high grounds.
3. Employees/residence of the SLCCL development will commence securing assets and other loose items.

12.3.3.6 Hurricane Warning – Red 1 Phase (Watch)

1. All employees are evacuated from unsecured areas and requested to take shelter.
2. All buildings and equipment are secured where possible and all other lose items securely stored.
3. Management will identify employees to report to work after the hurricane or after the Green Phase "All Clear" is announced.
4. The Hurricane Preparedness Coordinator for the company will inform DEMO/NEMO of key actions taken.

12.3.3.7 Hurricane Warning – RED 2 Phase

1. All employees are allowed to seek shelter.
2. All preparation completed
3. Batten down and weather the storm

12.3.3.8 Fourth Phase – Green (All Clear)

This is the ALL CLEAR, which will be declared by NEMO after the hurricane has passed and recovery plan activated.

1. Management will attempt to return and survey the farming site as soon as possible.
2. Management will immediately make a brief report on all damage or loss (supported with photographs), and prepare an estimate of damages, and submit the same to DEMO for action, if any.

3. Clean-up phase will commence with the assistance of employees and restoration of operation.

12.3.4 Fire Prevention and Response Plan

12.3.4.1 Introduction

The risk of fires and fire damage is associated with bush fires or those related to arson, smoking, cooking, electrical shortages, operating machinery and lightning. The fire prevention and response plan will focus on the possibility of a fire outbreak, whether large or small, that might occur.

Fire prevention will depend to a great extent on the measures taken to ensure the presence of firefighting equipment and the avoidance of any associated disaster. Bush fires in the farming area are most frequent during the height of the dry season (March-May).

The objective of the plan is to establish procedures and practices that will minimize the risk of fires and in the case of a fire it shall provide for its immediate suppression and notification.

12.3.4.2 Fire Prevention and Emergency Response Plan

The Fire Prevention and Emergency Response Plan shall include the following:

1. Immediately report all major bush fires to the Forest Department.
2. Prevent all workers from setting open fires.
3. Prevent the escape of fires caused directly or indirectly as a result of maintenance operations (welding works etc.) and extinguish all said fires.
4. Ensure the proper installation of electrical wires and their maintenance to prevent electrical sparks.
5. The Operations Manager shall ensure that all workers know their individual responsibilities in case of a fire, and how to operate fire suppression equipment by conducting fire prevention drills.
6. The Farm Manager or his Field Assistant will ensure that fire passes are completed and maintained prior to and during the Fire Season each year.

12.3.4.3 Fire Protection and Suppression Equipment

The project site will be protected from fire by means of the following:

Fire Suppression Systems

- **Fire Extinguishers***:* The proprietors of the SLCCL development will install multi-purpose dry chemical (Class ABC) fire extinguishers at various operation areas on the farm sites. Dry chemical extinguishers will range in sizes of 10 lbs. to 20 lbs. These will also be installed at key areas such as the maintenance buildings, and fuel storage areas. Each vehicle and farm equipment should also have its fire extinguisher.
- **Fire Pass**: The SLCCL development will institute a Fire Pass construction and maintenance protocol that will be activated during the annual Fire Season.

12.3.4.4 Fire Prevention

Fire prevention is perhaps the most important element of a fire contingency plan. Water is not a limiting factor. The headquarters and grain site has ready access to water for fire control. Water for suppressing fire is available from several ponds and the Sibun River. Fire passes will also be established and maintained in sensitive areas along forested zones. The SLCCL proprietors intend to have the following guidelines implemented:

Smoking and Fire Rules:

- Smoking shall be strictly prohibited in enclosed machinery cabins and near fuel storage area.
- A "cigarette butt extinguishing" culture, where all spent cigarettes are properly extinguished before discarding, will be instilled for all smokers.
- Signs regarding smoking and fire rules will be placed in conspicuous places for employees and farmers to see.

12.3.4.5 Fire Response

The extent of damage associated with a fire is often dependent on the response time and the adequacy of the response measures. While it is difficult to portray an ideal response plan that takes into account the different scenarios that might arise from a fire, it is important to have a general fire response plan with which all employees should be completely familiar. This plan should have guidelines for combating fires and the use of fire suppression equipment.

The management of the project will ensure that it develops an evacuation plan in the event of fires, particularly bush fires when these threaten the farming area.

All fires commence small, and their ultimate size will depend on how fast and effectively a respond is conducted. Since all fires require a source of fuel, oxygen, and a source of ignition, and are controlled by removing any one of these elements.

Recommended fire response actions:

a) *Sound an alarm (cellular phones, bells, etc.)*
b) *Report fire immediately to the Farm Operations Manager or the Proprietor.*
c) *Evacuate the area or structure.*
d) *Use an extinguishing media (fire extinguisher, buckets of sand, water etc.).*
e) *Remove all accelerants (*a fire accelerant is a material that is used to increase the rate of combustion for materials that do not readily burn) *away from the fire.*
f) *Have all electricity and power supply to the structure turned off.*
g) *Check to see that the fire is completely extinguished.*
h) *Inspect the fire area and assess for damage.*
i) *Close off the area for safety purposes.*
j) *Prepare a report of the incident and submit it to the Management for further action.*

12.3.5 Hydrocarbons Spills and Leaks Contingency Plan

12.3.5.1 Purpose of the Oil Spill Plan

Hydrocarbons such as diesel, gasoline and lubricants will be either stored or used during farming operations, hence requiring that all efforts be made to protect the area from any spills or leaks of hydrocarbons into the environment. The Oil Spill Contingency Plan (OSCP) is intended to guide SLCCL workers through the processes required to manage an oil spill or fuel leak in the farm/grain storage area or surrounding waters.

This plan focuses on the possible spillage of refined petroleum products, primarily diesel, gasoline and engine lubricants. The proposed plan will not only focus on the prevention of leaks and spills

but will also provide SLCCL employees with the appropriate training, materials and equipment, and guidelines to be able to contain these and respond appropriately.

This contingency plan describes information and processes for containing and cleaning up a spill or leaks. Because the approach and methods for responding to oil spills are constantly evolving, and each spill provides an opportunity to gain experience how to better prepare for future incidents, contingency plans are also constantly improving and providing increased protection to human health and the environment from these accidents.

The plan's three main objectives can be summarized as follows:

1. Increase employees' awareness of spill response procedures taking into consideration the different governmental tier response levels.
2. Define the coordinating mechanisms necessary for employees to utilize their resources in response procedures.
3. Establish and clearly define the roles and responsibility of the workers and farmers in spill contingency and response procedures.

This plan identifies the need for a timely and effective response to incidents involving leaks and spills. In order to respond rapidly and successfully to a leak or spill, workers responsible for containing and cleaning up the spill must know the steps that are required to be followed during and after the spill.

12.3.5.2 National Oils Spill or Chemical Spill Response Policy

The Environmental Protection Act makes it mandatory that any person using or exploiting the environment makes all effort to protect the environment against unnecessary damage or pollution by harmful substances. In addition, the pollution regulations make it mandatory that all spills and leaks are immediately contained and reported to the Department of the Environment. The Department of the Environment in close collaboration with NEMO has prepared a National Oil Spill Contingency Plan in which it outlines the response procedures, roles, and responsibilities of those involved.

Table 71 shows DOE's Inland Spill level as described by the National Emergency Preparedness Plan for Oil Spills (NEPPOS).

Table 71: Inland Spill Level.

Level	Quantity	Location	Response
A	<1,000	On land or Inland	To be managed by polluter
B	>1,000 or poses significant health hazard and requires evacuation	On land or Inland	The responsible party requires GOB assistance to manage the discharge.

Since the Spanish Lookout Community Corporation Limited (SLCCL) farming development will not be handling bulk fuel at the project area, Spill Level A is most applicable to the size and types of spills that could be associated with this mechanized farming development project in the mid reach of the Sibun River watershed.

12.3.5.3 Fuel Management

SLCCL management will focus on the prevention of leaks and spills through the implementation of a stringent fuel management plan which also addresses issues associated with spent or unusable oils and fuels. The fuel management plan will address issues with its transportation, transfer, and storage. Fuel will be managed to prevent spills and leaks via the following:

A. Transportation:

- During transportation the container (single metal tank or 45-gallon steel drum) will be checked for leakages and sealed properly.
- During transfer of fuel from containers to storage facility all lines will be properly connected before pumping and strictly supervised.

B. Storage:

- All fuel will be stored in above ground storage tanks which shall be placed within containment wall or secondary containment structures.
- The containment structures will be designed to contain 110% of the maximum tanks volume

if kept open exposed to rain.

- To protect against any accidental fire all fuel storage tanks will be sited away from all electrical installations and sources of exposed flames.
- Highly visible "No Smoking "and "Danger! Highly Flammable" signs will be posted on the site.
- Any fuel dispensed will be done within the containment area, and any spill will be immediately and appropriately dealt with through the use of absorbent pads which shall be stored in sealed containers within the fuel storage area.
- Soiled absorbent pads will be placed in specially lined plastic containers with covers and disposed of properly.

C. Documentation*:* All fuel received and stored on site will be properly recorded in a fuel ledger book.

D. Maintenance: SLCCL shall ensure the implementation of a strict maintenance program which will require regular inspection for spills and/or leaks of all storage tanks, containment structures fire extinguishers, pipes, valves, and generators.

E. Waste Oil Management:

Although waste oil will be produced in very small quantities primarily from the servicing of all equipment, used for transportation, earth clearing, ploughing, planting, and harvesting. Waste oil, if not appropriately managed, could pose a risk to the environment and surrounding water bodies. Oil containers for engines are another potential source. However, it is important to understand that a very small amount of waste oil can contaminate a large amount of water. Waste oil will be managed according to the following:

- *Storage:* All waste oil will be stored in properly sealed containers and inside a roofed containment area until transported outside the farm area for proper disposal.
- *Handling:* The use of waste oil will be strictly prohibited and all volumes generated will be properly recorded on a ledger which will also record the dates these are generated.
- *Disposal:* No waste oil shall be disposed of without the written permission of the DOE. All waste oil will be properly stored and disposed of in accordance with DOE's waste oil disposal program and guidelines.

12.3.6 Medical Emergencies

12.3.6.1 Introduction

Responding to medical emergencies in the SLCCL development site can be challenging due to absence of medical center in the immediate neighbourhood. A protocol must be established to ferry medical emergency cases immediately to the Western Regional Hospital in Belmopan or the Karl Heusner Hospital in Belize City.

12.3.6.2 First Aid Services

First Aid is the provision of limited medical care for sudden illness or injury, which is provided, usually by a certified person, to a sick or injured patient until appropriate medical treatment can be accessed. Applying First Aid to a patient consists of a series of simple, sometimes lifesaving, medical techniques, that an individual, either with or without formal medical training, can be trained to perform with minimal equipment. The SLCCL development will ensure that it has certified first aider to assist in this endeavour during field operations. Training will be sought through the Belize Red Cross. First aid kits will be available on the project site and at the Company Head Quarters at all times. This should include the basic first aid supplies.

Snake bite kit

Although the reptile list (Appendix VIII) list one non-venomous snake, the possibility exist that the development may have venomous snakes such as Neotropical rattlesnake (*Crotalus durissus terrificus*) or the Fer-de-Lance (*Bothrops asper*) commonly known as “Yellow jaw” or “Tommy Goff”, as these species are common in Belize. Therefore, management must be prepared in the event of these snakes or any other venomous snake are present in the area.

There are different schools of thought about Snake Bite kit contents. Therefore, management should ensure that they are aware of what snakes are present in the area. If a Snake Bite kit is provided, ensure First Aiders know how to use it.

12.3.6.3 Transportation (Evacuation) of patient

When a patient must be transported to a recognized health institution for further treatment as quickly as possible, the act of preparing the patient and notifying the institution is a very important and critical issue.

Time is of the essence and therefore important in a life and death situation. The SLCCL development Operations Manager will be required to make transportation arrangements to the health institution in the event of a medical emergency. The remoteness of certain cultivation blocks in the SLCCL farming site may warrant the use of a helicopter for emergency evacuation of injured or critically ill personnel. Such a mode of evacuation cannot be ruled out.

CHAPTER 13 IMPACTS TO BBRS OUTSTANDING UNIVERSAL VALUES

13.1 Introduction

The TOR requires that the EIA assesses the impacts to the Outstanding Universal Values (OUVs) of the Belize Barrier Reef Reserve System (BBRRS), World Heritage Site (WHS) designation relative to the projects activities (grain crops production, conservation and mining).

As of 2024, Belize only has only one World Heritage Site, the Belize Barrier Reef Reserve System (BBRRS) which was inscribed as a UNESCO World Heritage Site in 1996 (https://whc.unesco.org/en/list/764). The BBRRS WHS is comprised of seven protected areas:

1. **Bacalar Chico National Park and Marine Reserve- 11,399 ha**
2. **Glover's Reef Marine Reserve- 35,067 ha**
3. **South Water Caye Marine Reserve- 47,700 ha**
4. **Sapodilla Cayes Marine Reserve- 15,619 ha**
5. **Laughing Bird Caye National Park- 4,095 ha**
6. **Blue Hole Natural Monument- 414 ha**
7. **Halfmoon Caye National Monument- 3,954 ha**

13.2 Attributes of the BBRRS

According to the UNESCO World Heritage Convention web page (https://whc.unesco.org/en/list/764), the attributes or the elements of the BBRRS which convey its heritage/conservation values and enable an understanding of those values include:

"1. **Criterion (vii):** The Belize Barrier Reef Reserve System (BBRRS) is unique in the world for its array of reef types contained in a relatively small area. As the longest barrier reef in the Northern and Western Hemispheres and distinctive on account of its size, array of reef types and the luxuriance of corals thriving in a pristine condition it provides a classic example of the evolutionary history of reefs and reef systems. The rise and fall of sea level over the millennia, coupled with natural karst topography and clear waters, results in a diverse submarine seascape of patch reefs, fringing reefs, faros, pinnacle reefs, barrier reefs as well as off-shelf atolls, rare deep water coral reefs and other unique geological features such as the Blue Hole and Rocky Point

where the barrier reef touches the shore. The spectacular picturesque natural setting of brilliant white sand cayes and verdant green mangrove cayes is in dramatic contrast to the surrounding azure waters.

2. **Criteria (ix):** Illustrating a classic example of reef types, including fringing, barrier, and atoll reef types, the BBRRS contains an intact ecosystem gradient ranging from the terrestrial to the deep ocean. Including littoral, wetland, and mangrove ecosystems, to seagrass beds interspersed with lagoonal reefs, to the outer barrier reef platform and oceanic atolls, this ecological gradient provides for a full complement of life cycle needs, supporting critical spawning, nesting, foraging, and nursery ecosystem functions. Maintaining these ecological and biological processes ensures robust and resilient reefs, which are themselves one of the world's most ancient and diverse ecosystems, and

3. **Criteria (x):** Home to a diverse array of top predators, on land, sea and in the air, the jaguars of Bacalar Chico, the great hammerheads of the Blue Hole, and the ospreys of Glovers Reef are a testament to the property's importance and its ecological integrity. A total of 178 terrestrial plants and 246 taxa of marine flora have been described from the area while over 500 species of fish, 65 *scleractinian* corals, 45 hydroids and 350 molluscs have been recorded. Numerous endangered species are protected within the boundaries of the BBRRS including the West Indian manatee, the American crocodile and three species of sea turtle. The property also provides valuable habitat for three species of groupers, and the red-footed booby. The BBRRS is also home to endemic species including several Yucatan birds, island lizards, several fishes, tunicates, and sponges, making it an area with one of the highest levels of marine biodiversity in the Atlantic".

13.3 Integrity of the BBRRS

"The BBRRS is an interconnected system comprised of seven marine protected areas located along the length of the barrier reef, the shelf lagoon, and offshore atolls (https://whc.unesco.org/en/list/764). It is the largest barrier reef in the Northern hemisphere and represents all the main reef and coastal habitats, including rare littoral forest on sand cayes that are home to endangered flora and fauna (https://whc.unesco.org/en/list/764). The network of protected areas is large enough to maintain the necessary ecological processes and support the BBRRS for

the long term (https://whc.unesco.org/en/list/764). Its geographic spread and diversity enhance its resilience, an essential factor in this time of climate change with its risks of coral bleaching, stronger and more frequent hurricanes, and sea level rise (https://whc.unesco.org/en/list/764).

The main management challenges and threats that impact on the integrity of the BBRRS include overharvesting of marine resources, coastal development, tourism, and industrial development. These threats, common to marine protected areas in general are less intense due to relatively low population pressure, however, careful management is required to ensure growing population pressures do not lead to significant impacts on the integrity of the property (https://whc.unesco.org/en/list/764)."

13.4 Potential Impacts

With respect to impacts on the OUV's of the BBRRS World Heritage Site, this assessment has found that the proposed Project will have negligible impacts on the various criterion as the project does not lie within any of the seven protected areas included in the BBRRS WHS cluster group since its location is on mainland. Although there have been some concerns on the potential impacts of land base sources of pollution to the Belize Barrier Reef System and the potential impacts associated with the runoff of agrochemicals, the impacts associated with this individual farming development is likely to be very insignificant in the scheme of things. Presently the greatest impact to the BBRRS is more related to Climate Change issues, such as sea temperature rise which are completely external to national efforts to protect the system. In addition, most of the assessed impacts associated with the implementation of the project are readily mitigated with the proposed mitigation measures and best management practices.

CHAPTER 14 ALTERNATIVES FOR DEVELOPMENT

14.1 Introduction

This section analyses available alternatives for issues and environmental risks identified and suggestions in addressing environmental impacts. For each environmental parameter below, two alternatives were evaluated, and the no action alternative considered for the entire project at the end of the chapter. A comparison of alternatives helped to determine the best method of achieving project objectives while minimizing environmental impacts or and helped to indicate the most environmentally friendly or best practicable environmental option for development with the least environmental footprint. The environmental parameters include:

- Flora and fauna
- Water management
- Agrochemical management
- Waste management
- Infrastructure
- Social factors
- Climate change/adaptation
- Outstanding universal values

The analysis of alternatives is a systematic comparison, in terms of potential environmental impact, between the proposed investment design, site, and technology and operational alternatives – including the zero alternative (Source: Website: www.worldbank.org/eca/environment). It is designed to bring environmental considerations into all stages of development planning.

In many cases, however, a fully tiered approach may not be possible due to pre-existing situations, which in this case mitigation actions become necessary. Certain alternatives will be omitted by earlier stages of decision-making, especially if parts or the entirety of a project has already been pre-existing. Such is the case with the SLCCL project. Nonetheless, some alternatives may remain open and an assessment can help to identify them.

The development of feasible alternatives, to meet the overall objectives of the proposal calls for certain types of information and knowledge. During this process, for example, reference may be made to available technology, policy objectives, social attitudes, environmental site constraints

and project economics. It is important to make sure that the alternatives chosen for comparison with a proposal can be implemented cost-effectively.

The range of alternatives selected for analysis routinely includes the (no action) alternative. The relative impact of each alternative is compared against the baseline environment (versus without project) to select a preferred alternative. Options to be analysed should include taking no action alternative. However, the no action alternative does not always correspond because changes result from other actions. The evaluation of alternatives herein pertains to the evaluation of alternatives for the proposed environmental issues or parameters of a project.

14.2 Assessment of Alternatives for Development

Alternatives for development for this project were based on the following considerations:

14.2.1 Existing Land Use of the Area

Considering that the project area comprises part of an existing agriculture productive system, pre-existing conditions are as follows:

- A significant portion of the property had been previously cleared.
- The land system is an agriculture layout whose land suitability pre-dates the recent project amendments.
- The previous economic feasibility was made at the level of the investment decision by the project owners; which is very much consistent with the recommended land use potential of the project area and has a very positive economic feasibility.
- Alternatives and mitigation measures will be based considering the existing practices, technologies and conditions of the investment activities.

14.2.1 Evaluation of Development Options

The analyses of alternatives compared results in the selection of the preferred alternative for development based on environmental, technical and economic grounds i.e., the option with the highest cost benefit factor, the most technically feasible and with the least residual impact is identified as the preferred option.

The "No-action" alternative or non-development option is usually discussed as an option in the EIA process. However, this alternative is difficult to consider as a viable option considering the benefits of the proposed project, and given the pre-determined investment and expenses, the no action alternative is not deemed viable.

The investments already incurred were the primary reason for the no action alternative not to be found economically feasible. This option would result in the loss of economic opportunities and its related positive socio-economic benefits such as employment generation, revenue generation etc.

However, the EIA as a planning tool is considered critical for the determination of potential negative impacts, mitigation measures and as an important part of the process of identification of best technology for the project.

14.3 Flora and Fauna – Alternatives

14.3.1 Alternatives Considered

With respect to the flora and fauna, the options for reasonable investment are as follows:

Option A – Unchanged agriculture practices

Option B- Renewed agriculture practices using environmentally sustainable methods and mitigation.

Mitigation Hierarchy in Assessing Alternative:

"Mitigation hierarchy", are standards that set prioritized steps for limiting adverse impacts through avoidance, minimization, restoration and compensation as well as opportunities for culturally appropriate and sustainable development benefits (GCF, Environmental and Social Policy 2018).

The mitigation hierarchy aims to:

(i) Anticipate and avoid adverse risks and impacts on people and the environment;

(ii) Where avoidance is not possible, adverse risks and impacts are minimized through abatement measures;

(iii) Mitigate any residual risks and impacts; and

(iv) Where avoidance, minimization or mitigation measures are not available or sufficient, provide remedy and restoration before adequate and equitable compensation of any residual risks and impacts; (Source: GCF, Environmental and Social Policy 2019).

The two options listed above are option A for the continuation of the agriculture practices that do not consider significant mitigation planning as opposed to the second option that does incorporate mitigation and more sustainable practices.

An example of the application of mitigation hierarchy includes the site selection process, whereby a site which had already proven useful investment in the agriculture sector with reduced vulnerability to flooding and accessibility challenges was acquired, thus using the avoidance technique.

In terms of the protection of the biodiversity (flora and fauna), the following considerations in the mitigation hierarchy apply to the preferred Option B:

- The conservation of 32% of the total acreage (25% of total land for direct conservation and 7% as buffer for preservation of riverine ecosystem (150 feet of riparian zone)), for a total of 32%. See Table 72 for description of lands by acreage.

Table 72: SLCCL land use.

March 2024		
	Acreage	**Percent %**
Acres already Cleared	2751	41
Acres Bush to be Cleared	1301	19
Acres Mountains for Quarry	550	8
Acres Conservation Land	1649	25
Acres River and other Reserves	468	7
Total	**6719**	**100**

- Prevention of hunting and disturbance of wildlife.
- Apply species and farm management practices that include the selection of species that will reduce the necessary inputs of agrochemicals and minimize risks such as specie escape through various management regimes which will serve to ensure community trust in that the species will not become a nuisance to nearby agro-productive lands.
- Integration of Ecosystem in terms of the project's planning which includes the various ecosystem components such as the preservation of the conservation zone, and the

application of sustainable practices that include community use of preservation zones such as caves for continued sustainable use of its biological components.

The preferred alternative, therefore, is Option B, sustainable agriculture system.

14.3.2 Mitigation Measures for Previously Cleared Sites

In addition to the integrated ecosystem approach described above, the following practices will be adapted to mitigate already cleared areas:

- Installation of sediment traps to reduce siltation of river,
- Enhance habitat by remediation of disturbed areas and allow plant re-growth using native species,
- Monitor the physical parameters such as erosion control in order to make adjustments as necessary.
- Included in the water quality monitoring plan, areas that are already cleared.

14.4 Alternatives For Water Management

14.4.1 Sources of Water

The two alternative sources of water that were found to be most viable are as follows:

Option A – River water

Option B – Rainwater catchment

In terms of the mitigation hierarchy, the most important criteria here was the determination of the avoidance technique. That is; the nature of the agriculture cycle selected has eliminated the need for irrigation of crops, thus the activity with the greatest demand for water has been avoided.

The analysis of alternatives, therefore, is limited to the water demands only required for domestic purposes (drinking and domestic use of one family – caretaker family) and for the washing of equipment, tools, driveways etc. This water demand is estimated at less than 1000 gallons per month. This volume can be sustained by the river as a source of water during the peak of the dry season, but the rest of the year being supplied via rainfall that is collected using cisterns and containers.

The preferred option, therefore, is the combination of both supply options above, with rainwater catchment as the primary source, and the river as the alternate source to be used during the peak of the dry season (March to May).

This option warrants no further discussion in terms of alternatives, except to list the recommended mitigation measures as follows:

- Avoiding the long - term need for irrigation of crops and planning seasonal crops
- Use of local commercial water for drinking purposes and a combination of rainwater catchment supplemented by the river water during the dry season.
- The implementation of the water quality monitoring program to identify potential sources of pollution.
- Successful use of the 150 feet river buffer zone as a key measure to protect the river waters from pollution sources
- Implementing a system of sediment traps to reduce siltation and erosion.

14.5 Alternatives For Agrochemical Management

Agrochemical management is a combination of various techniques that aim to ensure maximum sustainable yield of crops, while ensuring protection of the environment, risk reduction to the environment, humans and wildlife, and cost reduction. The preferred means of pest control has been chemical application. However, this method poses environmental risks, which include a risk to human health, risk of pests becoming resistant, risk to pollinators, etc.

Several options have been analysed here. Three options are analysed herein which include:
Option A – No Action
Option B – Biopesticides
Option C – Integrated Pest Management

Option A – No action

One option is to practice completely non-chemical applications similar to organic farming practices. However, this option cannot apply to large scale farming since from time to time the outbreaks of diseases require input, and the production system requires fertilizer input to maximize

yields. An outbreak of a disease may render the crop an investment loss. This option, therefore, is eliminated primarily due to the risk of economic losses.

Option B – Biopesticides

Biopesticides which use natural sources of pest control applications (bacteria, fungi, yeast, and minerals). The advantages that this method has are that it does not lead to pest resistance, it does not harm the environment (including pollinators), decompose rapidly (preventing pollution) and does not pose a serious risk to human health.

The disadvantages are that these are not readily available in Belize, the shelf life of these products may pose a challenge, and the regulatory framework may require considerations.

Option C – Integrated Pest Management - Preferred Option

Therefore, an integrated and strategic chemical management system has been adopted that is outlined as follows:

a) Integrated Pest Management (IPM): The industry is increasingly promoting IPM practices, which combine biological, cultural, physical, and chemical tools to manage pests in an environmentally and economically sustainable way.

- The identification of pest resistance crops as much as possible, and the identification of the need for the application of agrochemicals based only after a brief risk assessment.
- The avoidance of human spraying and the use of drones for the spraying of crops when necessary.
- The safe transportation, storage and management of agrochemicals (pesticides and fertilizers).
- The adoption of emergency plans in the event of environmental hazards including accidental spills, accidental human contamination and the securing of agrochemicals during the passing of significant storms.
- Considerations should be made for the use of biopesticides which use natural sources of pest control applications (bacteria, viruses etc.). This method is best in a phased approach as it would be fairly new to the present farm.

14.6 Alternatives for Waste Management

14.6.1 Solid Waste Management

14.6.1.1 Assessment of Options

In terms of solid waste management, the two options considered are as follows:

Option A – On site Disposal with Composting

Option B – Waste Separation for Disposal at landfill (also includes composting)

Option A – On site waste disposal

On site management of waste can be considered only if long term temporary storage of waste is done for materials that are not degradable. Non degradable material that is not readily degradable would include metals, bottles, plastics, glass and contaminated containers.

Waste generation on site is fairly low. This is so since there is only one caretaker who resides on site with his family. Workers who work on site depart daily, taking most of their garbage to the source of origin. Nonetheless, solid waste management with onsite treatment would require the separation of non - degradable waste for local storage or burial. The practice of burying garbage is discouraged since this may lead to pollution in the long term as a result of leaching.

Also, degradable material can be composted or simply disposed around plants. Degradable organic material is mostly in the form of waste food, waste vegetables and plants.

The long - term risks to the environment that on site disposal poses render this option non feasible.

Option B – Disposal at Regional Sanitary Landfill – preferred option

Option B, which is the preferred option, calls for the separation of waste, with final disposal of nondegradable waste. Approximately 48% of waste generated in Belize comprises of degradable material. This includes food waste, leaf litter and similar biomass, as well as paper products.

Re-usable containers, such as bottles, plastic and bottle jars, drums, buckets, and such containers will be separated for re-use or stored for recycling. Scrap metals will also be stored for recycling.

Scrap timber may be used for firewood and leaf litter and similar biomass will be composted.

Non degradable and non - reusable waste will then be stored temporarily in closed containers such as drums and as soon as possible, these will be transported to the regional sanitary landfill. Such waste will include plastics, and construction material, if any.

The option of waste management through the separation of re-usable and material that can be recycled and final disposal of other waste at the regional landfill, is, therefore, the preferred option for environmental reasons.

14.6.2 Alternatives for Liquid Waste Management

Two options were analysed that can treat sewage waste and grey water as follows:

Option A - Compost Toilets

Option B - Septic Tanks (Existing) With leach fields

Again, the quantity of liquid waste is fairly small, thus this is the primary issue that has influenced the decision to stay with these options since other options are non-feasible.

Option A – Compost Toilet

Compost toilets have several advantages over septic systems and similar systems. One such advantage is that these do not require the use water for flushing but degrades waste through a natural process of decomposition into compost, making it one of the most environmentally friendly types of toilets for remote areas. Compost toilets are treated without chemicals and instead, the waste is converted into compost by adding mulch, sawdust or similar compost material. These materials are readily available from some farm suppliers. An additional advantage of this system is that since it uses no water for flushing, there is no need for connection to the water lines, reducing cost. However, small volumes of water for the sanitation of hands are required. Furthermore, the other advantage is that the final compost can be used to support gardens.

Option B - Septic tank and leach fields (Preferred Option)

The fact that no additional buildings are to be constructed in the near future is one reason why this option becomes the more feasible and least costly option. The residential buildings are already fitted with septic systems. However, for mitigation purposes the system will be fitted with a leach field for further treatment of sewage and gray water to reduce the risk of environmental contamination with this effluent.

Septic systems with leach fields may be more effective at preventing pollution since the wastewater is filtered and degraded by the use of gravel materials carefully laid to allow bacterial action of the wastewater. However, an important recommendation is for any new buildings to consider the option of installation of a compost toilet as a safer alternative.

14.7 Alternatives For Infrastructure

14.7.1 Transportation Alternatives on road Accesses

In terms of the transportation directly to the site, there are two viable alternatives as follows:

Option A – New Access Routes

Option B- Existing Access from George Price Highway and Coastal Highway

Option A includes the use of new additional accesses as an alternate route that is being considered for future use because at this time the associated infrastructure is already in place that supports the use of adequate accesses from the George Price Highway and the Coastal Highway. New access requires the presence of security personnel.

The existing accesses already have adequate controls and checks and the GPH access already has the location of the live-in security's living quarters. In addition, a visitor's house for use of management is also in place, and this site is also in need of security services that is in place. The use of new alternate accesses would require additional security measures, which would be costly and inconvenient.

Therefore, the preferred option at this time is to continue using the access from the George Price Highway and the Coastal Highway (Option B).

14.7.2 Options for Internal Road Materials

Options for accessing materials for internal roads are limited to the use of existing pits owned as part of the project. This option is pre-determined but has advantages that access can be done without exiting the property, thus reducing the traffic congestion of the highways.

However, hills with limestone resources have been set aside for future use as a source for the production of quarry material. These plans are long term and not foreseen in the next few years. At the time of this activity becoming a reality, it initially appears that access for the transportation to and from the quarry may best be suited from the route provided by the Coastal Plain Highway.

14.7.3 Alternative Access Route

Alternative transportation routes were considered based on the existing community setting with the objective of using the least populated route, which would reduce the social and environmental impacts of transportation to and from the site. The least trafficked rout is the approach from the Coastal Plain Highway, but the present site was pre-determined prior to acquisition of the property. As mentioned above, the existing buildings near the GPH access route do favour the use of this access and its proximity to headquarters located in Spanish Lookout. In the meantime, the present access requires warning signs to contribute to traffic safety. These signs should be installed with the advice and permission of the Traffic Department.

14.8 Social Factors

14.8.1 Stakeholder Engagement

Although the project is being planned within an existing agro-productive ecosystem setting, it does consider stakeholder engagement and community participation. The preserved lands south of the property includes several caves that are used by the local NGO for tour guiding and recreation. Access to this site has been agreed to between the landowners and the management of the Monkey Bay Wildlife Sanctuary.

Activities in connection with research and education at the remaining reserve are also possible and the sites are accessible with permission to the local NGOS and CBOs.

These community activities will benefit the wider community, enhancing an atmosphere of cooperation and participation. The benefits will also accrue to the owners of the investment in that they can have greater knowledge of the importance of preservation and protection of the flora and fauna of the site, thus contributing further to enhancement of the environment and cultural patrimony.

14.8.2 Social Impacts of Project

There are various potential negative and positive social impacts that were identified during preliminary investigations, and during the course of the ESIA preparations, which were elaborated and summarized herein. Positive impacts from the project include:

Agriculture and Food Security

Agriculture activities have the potential to contribute to Belize's food security and to the earning of foreign exchange as a result of the sale of produce.

Environmental and Ecosystem Health

The mitigative actions for the land use issues as well as ecosystem management issues are expected to be led through a series of propagation techniques with the aim at identifying resource conservation (water, soil, fertilizer etc.); crop management, integrated pest management and control as well as methods of extermination of the plant if and when the life of the project comes to an end.

In terms of its economic and job creation potential, the company offers equal opportunity to applicants for available posts in this sector. Job creation and indirect employment through the provision of services to the company and to employees are also well received social benefits.

14.9 Climate Change Adaptation

The phenomenon of climate change is already believed to be increasing the vulnerability to natural disaster risks. For example, during the 2019 year, Belize and the region experienced an extended drought. This drought resulted in effects such as reduction in crop yields and other impacts to the

agriculture sector. During the year 2024, Belize experienced an intense dry season, which led to numerous forest fires. As a result, the air quality was reported as being very poor for human health.

Risks from Natural Disasters include risks from:

- ✓ Human Health and Safety
- ✓ Increased risk and vulnerability to Hurricanes and Tropical Storms
- ✓ Flood Risks
- ✓ Forest/ Bush Fire Risks
- ✓ Risk of Diseases and Pandemics since climate change may lead to the proliferation of infectious agents.

Adaptation to these risks include avoidance, and mitigation. By selecting lands that have relatively low risk for flooding, and low risk for forest fires, the investors have avoided the need for detailed mitigation and adaptation measures.

Furthermore, the following considerations will contribute, albeit in small quantities to the climate change adaptation:

- Keeping preservation zones in a state of non-degradation and possibly enhancing these if robust vegetation is threatened. The green zones will sequester carbon, contributing to climate change adaptation.
- Enhance non-agricultural areas by the planting of fruit trees and ornamental trees, or trees that can contribute shade and habitat, for example along the fences.
- Apply techniques such as mulching of biomass to enhance productivity and thus reduce the need for burning, which will prevent additional contribution to greenhouse gas emissions.
- Use environmentally friendly sources of power, such as solar or wind panels to reduce dependency on fossil fuels.

14.10 Outstanding Universal Value

There is minimal risk that the project's activities can contribute to a reduction of the outstanding universal value of the world heritage sites being protected by UNESCO, namely the various sites along the Barrier Reef complex. The physical location of the project prevents immediate threats

to the barrier reef complex.

However, in the absence of mitigation, nutrification from organic fertilizer, and siltation can become cumulative, thus contributing to already existing background levels of these inputs and can eventually be flushed by water bodies along the coast of Belize. Therefore, in order to reduce this threat, mitigation measures such as the maintenance of a functional buffer zone along the river, as well as the installation of sediment traps, the application of sound agrochemical management will all contribute to the risk reduction.

All in all, the project that has preserved approximately 32% of its land resources for conservation will in the long term contribute cumulatively to the sustainable development that are compatible with the country's development and at the same time pose little or no risk to the outstanding universal value of world heritage sites.

14.11 No Action Alternatives

This project was conceived as a result of the suitability of the land for agriculture cultivation using mechanized practices. The agriculture - based activities that occurred on site had resulted in the installation of most roads and infrastructure such as buildings and storage facilities as well as drainage. Therefore, the investment would take advantage of existing infrastructure to reduce costs and to reduce the need for new disturbances for the most part.

The No Action alternative would not necessarily result in the environment remaining in its present stage as the previous landowner had implemented a program of phased land conversion from existing vegetation to agricultural cultivation. Therefore, in a scenario that this project did not materialize the property would still be subject to various environmental impacts including land clearing, vegetation loss, land alteration, land use change etc. The "No Action" alternative is therefore not deemed a viable option.

Alternative for Site Selection

The implementation of this project was based on several criteria including:

- Availability of suitable land for cultivation
- Availability of existing infrastructure that can contribute to project viability
- Availability of rainfall water for seasonal crop activities
- Availability of river water as an alternate source of domestic water during the dry season
- Access to Existing Highways for delivery of raw material and movement of finished products
- Relatively close to existing National Grid as the main source of power
- Significant buffer from communities to prevent health risks from crop spraying, noise and dust

Therefore, the selected land was found quite suitable and had high margin of profitability for this type of investment.

Habitat conservation through the contribution of available vegetated lands can contribute to the biological corridor which is essential for mitigating decline in biodiversity. The establishment of conservation areas within the project area is an important mechanism for achieving this aim. In addition to protecting biodiversity, conservation areas hold economic value: supporting local livelihoods, protecting watersheds from erosion, supporting flora and fauna, supporting thriving recreation and tourism industries, providing for science and education. These benefits will continue to grow in importance as the country develops.

CHAPTER 15 POTENTIAL CUMULATIVE IMPACTS

15.1 Introduction

This chapter provides a summary of the potential cumulative impacts associated with the most important activities of the project. While this agriculture project encompasses approximately seven thousand acres, a considerable portion of the land mass had already been under agriculture cultivation over the past. However, the impacts can be new or can be cumulative in terms of the additional environmental, social and economic effects from the present and future implementation of activities associated with the Project. Potential cumulative impacts were considered in the context of: (i) the existing environments (biologic, social and economic), (ii) stakeholder views (assessed through consultation), (iii) regulatory/industry norms (iv) planning and management.

15.2 Impact Assessment Methodology

The potential impacts associated with this proposed project have been identified based upon knowledge of the existing environment, experience with similar operations elsewhere and issues raised by stakeholders.

The relevant impacts are described in terms of their significance at the local, regional, or national level as appropriate. Potential impacts are compared looking at these impacts without control measures in comparison to the residual impacts after employing mitigation measures Best Management Practices (BMP) to address the impacts. Mitigation measures also included recommended control and management strategies proposed based on the nature of each impact.

The final aspect of the impact assessment involves describing the level of residual risk associated with each identified impact, assuming effective implementation of the proposed control and management strategies relevant to each identified impact.

15.3 Objectives and Measurement Criteria

The environmental and social objectives are accompanied by measurable criteria that can be used to assess progress towards compliance with the objectives. Where possible, measurement criteria

are based upon relevant standards and industry guidelines to adequately provide measurable assessment criteria.

15.3.1 Impact Matrix

The connectivity or hierarchal nature of the impacts of the proposed project has been reinforced by the integration of a residual impact rating matrix. An environmental impact is defined as *"any change to an existing condition of the environment*". The nature of the impact may be categorized in terms of:

- **Impact Type**: Positive (+) or Negative (-);
- **Direction**: Direct (D) or Indirect (I);
- **Magnitude**: High (H), Medium (M), or Low (L);
- **Duration**: Short term (S), Medium (M) or Long term (L);
- **Scope**: Unavoidable (U), Avoidable (A);
- **Significance**: Low (L), Medium (M) or High (H);
- **Medium:** Cross Media (CM), Cumulative (C); and,
- **Reversibility:** Reversible (R), Irreversible (IR).

The impacts considered in the risk assessment are summarized in the following list:

15.3.2 List of Impacts considered

- Terrestrial and aquatic Biodiversity and wildlife abundance/health
- Water quality and water resources within the project site
- Possible effects on the water bodies in the surrounding area
- Hydrographical characteristics
- Topographical characteristics
- Land Use Pattern and potential land use conflicts
- Infrastructure – roads, buildings
- Socio-cultural environment (including employment opportunities)
- Changes in the abundance of pests and vectors

15.4 Potential Impacts To Flora

15.4.1 Impacts to Threatened Species

Vegetation clearing will reduce habitat and may reduce the abundance of flora species with consequent impacts to populations of a threatened wildlife species at the local level.

Clearing vegetation will be necessary during implementation of the Project. The clearing process will remove plants from the broader species populations in the project area which may have adverse effects on plant species abundance at the local level.

15.4.2 Control and Management Strategies

Impact on threatened species. The flora survey conducted for the area shows a mixture of vegetation types. However, the prevalent vegetation type is the lowland broadleaf forest. Most of this will be cleared and eventually over 60% of the vegetation will be cleared.

Reduced species abundance: Previous logging in the property has resulted in the removal of most of the commercially valuable species such as mahogany, cedar etc. Land clearing will result in the removal of a number of the few remaining species in the areas proposed to be cleared which for the most part is of limited commercial timber value. Nonetheless, it is recommended that the few trees with commercial value should be harvested for possible use within the project site as timber or for aesthetics and reforestation. These may include timber that can be used for fencing, and similar activities.

Vegetation removal results in habitat loss for wildlife and in ecological and aesthetic values of the landscape. Eventually soil compaction also leads to the production of dust and some erosion is possible.

15.5 Potential Impacts To Fauna

A few species of mammals that may be found in the project area have been and are threatened by anthropogenic influences outside of the property, specifically the illegal hunting of these animals for their meat (e.g. deer).

15.5.1 Potential Impacts to Fauna

Potential impacts to fauna from the Project are described below and include adverse Impacts on the abundance of threatened or non-threatened native fauna species or communities.

Reduced Species Abundance

There is potential for species abundance to be reduced as a result of:

1. Native fauna habitat destruction during clearance activities,
2. Scaring away animals during land clearance and farming activities, noise from heavy equipment and traffic movement disturbing resident populations of native fauna (birds) within the Project area.

15.5.2 Control and Management Strategies

The control measures and strategies to manage the project-related risks to fauna are outlined below.

1. Leaving a conservation area of 1649 acres or 25% of the property untouched and set aside for conservation and ecotourism development activities.
2. A river reserve riparian forest of 468 acres or 7% of the land mass, considered to be a relatively wide riparian buffer of 150 feet along the Sibun River to provide corridors linking forested areas bordering the property.
3. The riparian forest along the river is already established but this is being widened and will be maintained and the prevention of fires in this area will be given special attention.
4. The presence of grain crops could act as an additional attraction for wildlife and birds in adjacent forested areas, which may allow for increase in the population of these species.

The likelihood for significant impacts to threatened or endangered species is low but probable. This is because of the presence of a few in the general region of the project area. The presence of deer and tapir have been reported by observation of the scat from these animals.

15.6 Potential Impacts To Water Bodies

15.6.1 Potential Impacts

The major surface water body associated with the project is the Sibun River that flows through the property from a south to north direction. Several small streams that drain individual subsets of the watershed flow into the Sibun River. For the most part these are seasonal (ephemeral in nature). Potential surface water impacts due to project related activities are limited to the following:

1. Contamination of water bodies; Contamination from project-related activities, such as agricultural runoff primarily with fertilizer or pesticides to the Sibun River and discharged via drains may result in contamination. Contamination could occur from contaminants in surface runoff that empty into these creeks.
2. Agricultural runoff may also lead to increased siltation of small creeks that flow during the rainy season and the Sibun River itself.
3. Erosion as a result of land clearing can lead to siltation of small creeks which can change the flow characteristics and volume of water available to wildlife.

15.6.2 Control and Management Strategies

Control and management strategies that will be used to minimize the impacts of the Project on surface water impacts are outlined below:

1. The drainage network around the farm will be suitably designed to minimize contamination of land and the river such as the construction of sediment traps at the end of drains before their discharge into the river.
2. Best management practices for the construction of access roads will be implemented during road construction and clearance of associated sites at all times.

3. Integrated Pest Management strategies involving crop rotation and other methods aimed at reducing the use of agrochemicals.
4. Application of agrochemicals will utilize BMP to reduce impacts to human health and the environment, with special attention given to adjacent protected areas, Sibun River and tilapia fish farm.

15.7 Potential Impact To Hydrographical/Hydrological Characteristics

15.7.1 Potential Impacts

The project planning does not include the withdrawal of water for irrigation from the river and neither from wells, except in extreme draught condition, due to climate change, which threatens crop production. The clearance of the existing stands of forested area proposed for additional planting of grains and the construction of new drains in the area are two of the main activities that may alter the hydrological or hydrographical characteristics of the project area in the site preparation phases but not in any significant way. The proposed agricultural activities and the use of agrochemicals and the impacts of agricultural runoff containing sediments from soil erosion and agrochemical are the two main activities in the operational phase that will have the greatest long term impacts hydrographical/hydrological characteristics of the project area. The use of water for domestic use is the largest demand of water during the dry season requiring small volumes of water to be abstracted during the peak of the dry season (April and May) since the cisterns tend to go empty. The estimated water to be abstracted for domestic use is minimal, since only one family resides on site.

The potential impacts are assessed as moderate and long term with the potential for these to be significantly reduced with adequate management measures and the implementation of the recommended mitigation measures.

15.7.2 Control and management strategies

The primary control measure to avoid changes to the river water flow is to avoid large abstraction of water for irrigation. The other impacts and recommended mitigation measures are summarized in Table 73.

Table 73: Impacts and mitigation measures to hydrographical/hydrological characteristics of the project area.

Activity	Impact	Mitigation
Land clearing (secondary & primary forests) and soil removal / mining	Removal of habitat and food for native fauna. Change in local hydrology and microclimate. Erosion and increased sedimentation	Reduce land clearing acreage. Keep at least 25 % of land in reserve to ameliorate impact on hydrology and wildlife habitat. Do minimal tillage.
Agrochemical application in the general farming blocks	Leaching into soil and groundwater. Runoff into surface water bodies. Dispersed into nearby farms	Reduce aerial application as much as possible. Plan mechanical or drone application to coincide with rain/dry events. Implement Integrated Pest Management.
Access road construction and maintenance	Increased erosion; damming and soil disturbance	Minimize earth/soil disturbance as much as possible. Ensure zero oil leakage in fields. Practice sustainable mining.
Drainage	Change hydrology of wet land; disturb/destroy aquatic habitat; reduce flooding and improve land use	Stabilize drainage banks and reduce effects on natural wetlands as much as possible. Construct settling ponds. Direct drainage towards river and streams. Schedule drainage maintenance.
Water Abstraction from Sibun River, ponds, streams and/or groundwater	Reduction in water quantity to users downstream	Keep within limits of abstraction license. Have a water conservation plan.
	Change water quality of surrounding surface water; change water table; possible contamination	Keep within limits of abstraction license. Have a water conservation plan. Avoid contamination of groundwater sources.
Degrading Riparian Forest Buffer (RFB) and/or floodplain	Increase erosion and sedimentation. Loss of habitat wildlife. Shade and food source for aquatic organisms	Respect the 150 ft riparian forest buffer (RFB) strip along the Sibun River, Restrict deforesting or degrading RFB.
Water use amenities(minimal)	Decrease water availability. Affect surface and groundwater and may increase leaching and salinization (insignificant)	Use an efficient system that will conserve water and reduce loss by leakage and evaporation.

15.8 Potential Impacts to Project Area's Topography

The property is located at the intersection of the Belize Coastal Plain and the Central Foothills. There are some hills towards the south of the property. The vegetation on these hills will remain uncleared. However, a significant portion of the vegetation of the hilly terrain as well as the pine savannah has been affected by the wildfires during the past dry season.

15.8.1 Potential Impacts

The potential environmental impacts as a result of vegetation changes to the topography include:

- Increased erosion from land clearing
- Change to existing surface water flow rate and direction
- Change to vegetation type

15.8.2 Control and management strategies

The following control and management measures will be used to minimize the risks associated with changes to topography;

1. Land clearing will be limited to the flood plain and high plain area and the hilly section of the property will be left in its natural state.
2. The drainage system will be constructed to minimize erosion.
3. A150 feet wide buffer zone riparian vegetation will be left bordering the Sibun River.

15.9 Potential Impacts To Land Use Pattern

15.9.1 Potential Impacts

Part of the property is presently being used for agricultural purposes. The Monkey Bay Private reserve uses a portion of the property to conduct tours to the nearby caves. These caves are located away from where land clearing will be conducted. No other activity is occurring at the site. The proposed zoning planning for agricultural uses of flat lands and setting aside hilly areas for conservation and future mining activities are consistent with the land use potential of the project property.

The potential impacts on current and future land uses due to Project Development without appropriate control measures in place include:

1. Contamination of soil. Soil contamination may occur from Project related activities because of potential fuel spills and improper disposal of waste effluent. Soil contamination could inhibit re-vegetation and limit suitable future land use.
2. Soil erosion. Removal of vegetation may result in topsoil and subsoil erosion, with subsequent impacts on the future uses of affected land.
3. Changes to surface water flow. Land clearing may result in changes to water flow as well as stream morphology due to stream alteration.

15.9.2 Control and Management Strategies

Control and management strategies that will be used to minimize the impacts of the Project on land use are directed towards reducing or limiting soil contamination and erosion on present or future land use. These strategies include:

1. All bulk storage fuel tanks and fuel storage areas will be appropriately stored and labelled.
2. All farm roads will have a grass buffer to minimize erosion.

3. Erosion controls systems (e.g., drains and culverts) will be put in place for controlling surface water runoff.

4. Land clearing will be conducted as much as possible during the dry season. This will minimize the creation of ruts that can eventually lead to increased erosion.

5. Land clearing is expected to be limited to one or two operations and planting will be done as soon as the land has been prepared. Land clearing will normally be done during the dry season and the temporary windrows will assist in decreasing erosion rate. Soil erosion will therefore be localized and further reduced by use of grass buffers on the road shoulders.

6. Land clearing will be done using bulldozers and chains as this reduces soil compaction. Soil compaction is then limited to the movement of cleared vegetation by equipment that uses tires, thus minimizing soil compaction.

The impacts to land use by soil erosion are considered to be likely. When impacts occur, they will be localized and able to be remediated hence, the consequence on land use through soil erosion is therefore minor.

15.10 Potential Impacts Due to Infrastructure – Roads and Buildings

15.10.1 Potential Impacts

Since the property was previously under agriculture cultivation for many years, most of the structures are in place, including dwellings, storage sites, garages and roads. Ony a few new access roads, and drains will be installed in the new land areas to be cleared.

15.10.2 Control and management strategies

Control and management strategies that will be used to minimize the impacts of the Project on use of existing infrastructure include the avoidance of excessive land clearing, and the landscaping possibly with fruit trees in areas where vegetation was removed as a temporary measure.

15.11 Potential Impacts to Socio Cultural Environment

15.11.1 Potential Impacts

Public Health, Safety and Transportation

Potential environmental impacts as a result of public health, safety and transport include the potential for the traffic incidents, the increase in the degradation of road surfaces from increased vehicular movement, as well as possible increase in noise and air pollution.

The internal road system will need to be upgraded to support heavy vehicles such as combines and large tractors. Road surface degradation will occur and will increase with time. This is a natural consequence of its use.

Noise

The issues associated with noise are closely linked to increased traffic and the use of the various farm equipment to be operated on site. However, there is a significant buffer from nearby communities, thus reducing the impact to humans.

Socio-Cultural Changes, Infrastructure, And Employment Opportunities

Positive impacts from employment generation and from the demand for services will contribute to the local economy.

A few potential negative impacts can also result from any development of this nature. These may include increased demand for utility services, such as electricity, water, health services, telecommunication, and goods that are needed to operate the farm. There is also the potential for increased exposure to unintentional agriculture fires. However, the practice of burning at this farm will be limited to small quantities of debris.

Characterization of Potential Negative Impacts.

Tables 74 and 75 summarize the characterization of the potential impacts during the site preparation and the operational phases. Impacts are characterized based on Magnitude, Duration, Scope, Benefits, and Reversibility.

15.11.2 Control and Management Strategy

Control and management strategies that will be used to minimize the social impacts of the Project include the following:

1. Access from the property to the George Price Highway and the Coastal Highway will be clearly demarcated so as to have adequate visibility of the highways in order to reduce the risk of accidents.

2. The Project will have a road maintenance plan to ensure that the roads are maintained in a roadworthy condition.

3. Mitigation against noises from equipment operation is hardly practical, but the area is a bit isolated from public centers and residences. All vehicles and farm equipment will be outfitted with mufflers.

4. As mitigation against agricultural or bush fires, there is a need to limit burning and avoid setting of fires.

15.12 Potential Changes to population of Pests and Vectors

15.12.1 Potential Impacts Farm Practices on Pests and Vectors

Large-scale grain farms, such as those proposed in the project, can significantly impact the abundance of pests and vectors. These are primarily due to the fact that large grain farms often practice monoculture, which means growing a single crop over a large area. This can lead to an increase in pest populations that specialize in that particular crop, as they have an abundant and continuous food source. This coupled with habitat alteration that sometimes leads to a reduction of biodiversity and reducing or sometimes eliminating natural predators of pests which can also lead to an increase in pest populations.

In addition, to manage pests, large farms often rely on pesticides. While this can reduce pest populations in the short term, it can also lead to pesticide resistance over time, making pests harder to control. Studies have also indicated the potential for an increase in vector-borne diseases, such as mosquitoes, that transmit diseases. For example, irrigation practices can create standing water, which serves as breeding grounds for mosquitoes.

Climate Change

Agriculture and farming activities are economic activities that depends heavily on climate and certain weather conditions to ensure food production, rainfall and sunlight being key inputs required, among others. Moreover, agriculture is an activity that is exceptionally vulnerable to climate change and the impacts of climate change are characterized by various types of uncertainty.

As a result, climate changes such as temperature increase, humidity increase and rainfall increase may lead to the proliferation of pests, and vectors that carry certain diseases. For example, increase in excessive rainfall and moisture is resulting in increased proliferation of fungal diseases in certain crops . Furthermore, moisture, increased heat and humidity can lead to the decay of farm products then attract vectors, rodents, insects and some of these may cause illnesses and diseases.

Excessive rainfall can also change the regime of insect populations since heavy rainfall often washes away insect egg and larvae as well as small insects from the soil layer (Lemic et al., 2021).

15.12.2 Control and Management Strategy

To offset some of these impacts the project intends to practice crop rotation and to utilize Integrated Pest Management (IPM) strategies, which combine biological, cultural, mechanical, and chemical control methods.

Successful agriculture production requires successful planning and management. Best management practices are often put in place to mitigate crop loss, increase crop growth and crop yield, conserve and protect against soil loss, conserve water and energy to enhance the environment reduce environmental impacts, and increase climate resilience.

The following recommendations may be considered in order to increase the chances of successful agriculture practices and environmental protection (source: Modified from LLES for Caribbean Investment Limited, Wilderness Consulting, 2023).

1) Explore the risk of the crop before selection; ensuring that the crop is suitable, and its investment can yield positive gains.

2) Prepare a basic outline or conceptual zoning for the farm and seek the advice of agriculture experts (such as extension officers) before finalizing the designs.

3) Based on the topography and based on best location as well as physical features, and cultural features (areas of cultural or archaeological interests); establish buffer zones around these as recommended by experts and by the archaeologists if a mound has been identified within the parcel.

4) Avoid cultivation on the upper half of the steep slopes.

5) Crop selection. Crop selection must not be only based on potential efficiency and yield. Crops that are seasonal and can be planted for growing during the rainy season need to be made.

7) As much as possible reduce the use of pesticides and practice environmentally friendly pest control such as biological and integrated pest management that contributes to sustainable farming.

8) Select technology based on environmental grounds and based on efficiency. Solar and wind-based sources of energy may be suitable, and the use of composting, and low-energy alternative sources for lighting or other such energy needs should be done.

9) Report any abnormal observations in crops such as diseases or nuisance pests, so that agriculture and other authorities can intervene before the proliferation of pests or diseases.

11) Adopt climate-smart programs. For example, install water catchment basins that can serve as runoff for silt and soil as well as a source of irrigation during dry periods. Another example is to ensure buffer zones and vegetation cover for crops that are subject to intense heat and sunlight. Re-use water, reuse waste containers, and adopt other climate-smart practices.

12) Research. Farmers are encouraged to follow the more detailed guidelines for agriculture activities prepared specifically for cultivation in Belize.

Table 74: Potential cumulative impacts and impact ratings - Site Preparation Phase.

Affected Medium	Activity & Impact	Type of Impact & Direction (+ or -)	Magnitude	Duration	Scope	Significance	Medium & Reversibility
Biological /Terrestrial and aquatic	Flora and Fauna/ Land clearing/land preparation/ Installation of drains	- Neg. - Direct	High	Short	Local	Medium	Cumulative Reversible
	Movement of heavy equipment	- Neg. - Direct	Medium	Short	Local	Medium	Reversible
Water Quality/Water resources & Water bodies	Fertilizer input (risk of nitrification)	- Neg. - Direct	Medium to long term	Medium	Local	Medium	Reversible
	Risk for sewage and hazardous material contamination	- Neg. - Direct	High	Long term	Regional	High	Can be irreversible
Hydrographic Characteristics of water bodies	Minor risk (Irrigation during extreme draught conditions and withdrawal for domestic use during dry season)	- Neg. - Indirect	Low	Medium	Local	Low	Reversible
Hydrological features	Minor risk to River basin	- Neg. - Direct & Indirect	Low	Medium	Local	Low	Reversible
Topographical characteristics	Land use change with drains and soil tilling	- Neg. - Direct	Medium	Long term	Local	Medium	Reversible
Land Use pattern (land use conflicts)	Lands are designated for agro-productive system/ Reserve areas accessible to NGO	- Pos. - Direct	Medium	Long term	Local	High	
Infrastructure	No new homestead	-					

Socio-Economic	Risk to human health if agrochemicals are managed inadequately	- Neg. - Direct -	Medium	Medium	Regional		Reversible with some issues irreversible
	Labour and employment	+ Pos. Direct & Indirect	Medium	Long term	Local	Medium	
	Pests and pest management	- Neg. Direct	Medium	Medium term	Local	Medium	Reversible and preventable

Table 75: Potential Cumulative Impact Ratings – operational phase.

Affected Medium	**Activity & Impact**	**Type of Impact & Direction (+ or -)**	**Magnitude**	**Duration**	**Scope**	**Significance**	**Medium & Reversibility**
Biological /Terrestrial and aquatic	Flora and Fauna/ Land clearing/land preparation/ Installation of drains	- Neg. - Direct	High	Short	Local	Medium	Cumulative Reversible
	Movement of heavy equipment	- Neg. - Direct	Medium	Short	Local	Medium	Reversible
Water Quality/Water resources & Water bodies	Fertilizer input (risk of nitrification)	- Neg. - Direct	Medium to long term	Medium	Local	Medium	Reversible
	Risk for sewage and hazardous material contamination	- Neg. - Direct	High	Long term	Regional	High	Can be irreversible
	Risk of siltation of river due to erosion by wind and rainfall	- Neg. - Direct	Medium	Long term	Local	Medium	Can be avoided with mitigation planning
Hydrographic Characteristics of water bodies	Low risk (Irrigation only in extreme drought where it threatens crop production – in other cases only withdrawal for domestic use during dry season)	- Neg. - Indirect	Low	Medium	Local	Low	Reversible
Hydrological features	Risk of erosion and sedimentation	- Neg. - Direct & Indirect	Low	Medium	Local	Low	Reversible
Topographical characteristics	Land use change with drains and soil tilling	- Neg. - Direct	Medium	Long term	Local	Medium	Reversible
	Loss of soil due to wind and rainfall erosion	- Neg. - Direct	Medium	Long term	Local	Medium	Reversible and avoidable
Land Use pattern (land use conflicts)	Lands are designated for agro-productive system/ Reserve areas accessible to NGO	- Pos. - Direct	Medium	Long term	Local	High	
	Land use change resulting from land clearing	- Neg. - Direct	High	Long term	Local	High	Reversible in the long term
Infrastructure	No new homestead	-					

Socio-Economic	Risk to human health if agrochemicals are managed inadequately	- Neg. - Direct	Medium	Medium	Regional		Reversible with some issues irreversible
	Labour and employment	+ Pos. Direct & Indirect	Medium	Long term	Local	Medium	
	Pests and pest management	- Neg. Direct	Medium	Medium term	Local	Medium	Reversible and preventable

15.12 Extent and Quality of Available Data

The research team did its work within the context of an existing agriculture project. This site was a fully functioning mechanized farm for years prior to the new owners acquiring the property for continuation of mechanized agriculture farming. Therefore, the EIA was focused on the principal areas of research, being gathering of baseline data and recommending mitigation measures based on the findings but also influenced on the existing practices.

Data was available in terms of the property layout and farm design from the owners. Existing data of flora and fauna was limited as large portions of the property had already been cleared for cultivation. However, transects for the gathering of baseline data on flora and fauna was done to represent the existing but fragmented ecosystems. Important research previously done by King and Others, 1992 was used and supported by local soil sampling and analysis, as well as further research into the Geology of the area, being supported by the Geology Map of Belize, compiled by J.H. Cornec (J.H. Cornec, 2010a).

In terms of available literature, some reports for projects nearby were helpful in terms of indicating the flora and fauna. For example, the EIA documentation for the Coastal Highway Rehabilitation project gave an indication of the type of flora in the ecosystems nearby. Similarly, the LLES for Cementos Progresso and the flora and fauna information collected over a more extended period of time from the two nearby conservation protected areas (Monkey Bay wildlife Sanctuary and Runaway Creek Reserve) would indicate that the faunal species and their composition is likely to be similar for that of the project area.

There was also valuable archaeological information on the general archaeology of the area in particular the Hilly terrain portions containing caves with a few archaeological artefacts. The availability of LiDAR imagery of the project area was also very useful in the assessment of the project area.

CHAPTER 16 MITIGATION AND MONITORING PLANS

16.1 Introduction

The SLCCL Limited investment group has acquired 6,719 acres of land, most of which was previously under development for agriculture land use. Principal activities of the proposed project will include: (i) Site preparation and planning (ii) Land clearing, (iii) Tilling (iv) Planting, (v) Harvesting, and (vi) Transportation of products, and (vii) Decommissioning phase.

This section of the Environmental Impact Assessment Report summarizes the recommended mitigation measures designed to address the potential environmental impacts that the project may have on the environmental and social conditions of the study area. In many cases, these adverse impacts can be minimized to the point where they become insignificant or negligible. This can be achieved through effective project design, the application of green technologies and best management practices, or through sound operational management of the project and its associated activities.

A successful mitigation strategy hinges on the accurate identification of potential negative impacts and their implications, followed by the development of a comprehensive Environmental Management Plan (EMP). The proposed EMP focuses on identifying and implementing effective management tools and best practices, supported by a continuous process of monitoring and improvement. Implementing environmental management standards, adhering to best practices, and following established protocols are crucial in reducing environmental impacts, as measured by objective criteria. Consequently, the environmental management plan for the proposed project and its supporting activities involves the close integration of the following two components:

1. Environmental Impact Mitigation Plan – Impact mitigation is the most critical component of the environmental study process. It aims to prevent adverse impacts from occurring and keeps those that do occur within an acceptable level.

2. Environmental Monitoring – Environmental monitoring provides information that can be used for documentation of the residual impacts that result from the construction and

operational activities. This information enables more-accurate prediction of the associated impacts and the necessary feed- back mechanism essential in adjusting the EMP. Therefore, the monitoring system is a platform of measuring projected impacts and also in identifying unanticipated adverse impacts or sudden changes in impact trends essential in the implementation of an environmental management program based on the concept of constant improvement.

The social components of the EMP include community engagement (though conservation efforts), as well as worker's health and safety. It is intended to also provide the project management with recommendations to foster community health and to address worker's occupational health and safety related issues, while promoting sustainable development and a healthy working environment.

16.2 Summary of Potential Impacts

Any development irrespective of the nature of the undertaking would generate impacts. There can thus be either direct or indirect impacts both qualitatively and in terms of quantity on the physical aspects of the environment, namely land use, soil and geology, flora, fauna, air quality, water quality, noise and the landscape. The impacts could also be reversible or avoidable or a combination of both depending on the nature and complexity of the project. Apart from the impact on the physical environment, this undertaking will have a positive significant impact in the energy sector as well as the socio-economic aspect which includes employment and reduction of carbon emission among others. An assessment of the likely impacts of the project on these environmental components has been conducted and elaborated in greater detail. Table 76 provides a summary of the assessed main environmental impacts associated with the project activities.

Table 76: Major Potential Environmental Impacts of the Project Area.

Activity	Impact	Type	Magnitude	Scope	Duration	Avoidable	Reversibility
Land clearing, earth movement, and construction. Mining of karst hills	Removal of habitat and food for native fauna. Change in local hydrology and microclimate. Erosion and increased sedimentation. Impacts on biodiversity and the landscape.	Adverse	Medium to High	Direct	Long term	No	Yes
Operating heavy machinery in land preparation and harvesting, and transportation.	Leaching of contaminants into soil and groundwater. Runoff into surface water bodies. Increased sedimentation. Impact on fauna due to increase human activity and increased noise level. Loss of biodiversity. Soil compaction.	Adverse	Low to medium	Direct	Long term	Yes	Yes
Access road construction and maintenance on farmlands	Increased erosion, damming and soil disturbance. Disturbance to wildlife. Soil compaction of road surface.	Adverse	Low	Direct	Short term	Yes	Yes
Drainage	Change hydrology of wet land; disturb/destroy aquatic habitat; may reduce localized flooding and improve land use	Adverse	Medium to high	Direct	Long term	Yes	Yes
Water Abstraction from Sibun River for irrigation	Unlikely at inception. Reduction in water quantity to users downstream later.	Adverse	Medium	Direct	Long term	Yes	Yes
	Change water quality of surrounding surface water; change water table.	Adverse	Medium	Direct	Long term	Yes	Yes
Degrading Riparian Forest buffer and floodplain	Increase erosion and sedimentation. Loss of habitat for wildlife. May affect shade and food source for terrestrial and aquatic organisms. Could exacerbate flooding	Adverse	Medium to High	Direct	Long term	Yes	Yes

16.3 Mitigation and Monitoring Plans (ESMP)

The environmental impact matrices and corresponding mitigation measures are divided into the site preparation, and Implementation or operational phases. The following Tables 77 to 81 provide details of all necessary mitigation measures as well as the responsible party for implementing and monitoring such measures.

16.3.1 Mitigation Matrices for the Preparation/Planning Phase

Table 77: Mitigation Matrices for Preparation and Planning Phase.

Activity/Objective/Impact	Action Required	Responsible Party	Frequency
Activity: Project planning and preparation by establishment of camps and equipment on site. ***Potential Impacts: Risk of oil leakage, noise, and air emissions, soil erosion***			
Objective 1): Ensure adequate standards are met during the initial design phase			
Environmental Considerations and sensitivities of the area	All road works are to comply with the approved standards for farm roads.	Manager/Engineer/ construction crew (heavy equipment operators)	Once-off
Plans for roads and land works	The site development plan and all other construction drawings shall be verified on site prior to the onset of any construction work. Any discrepancies must be brought to the attention of the Engineer.	Manager/Engineer/ construction crew (heavy equipment operators)	Once off and during construction
Actions pertaining to the environment	Ensure equipment are well-serviced to reduce potential leaks	Operators	As frequent as necessary
Objective 2: Occupational health and safety			
All operations	Management must ensure that fire extinguishers are in strategic and visible places.	Manager	Once-off
Provide adequate facilities for staff (rest rooms, emergency plans)	Manager	Continuous	
Staff need to be informed on the necessary safety procedures and be competent in the work they are employed to do.	Manager	Continuous	

16.3.2 Mitigation Matrices for Site Preparation phase

Table 78: Mitigation Matrix for Environmental Impacts.

Activity/Objective/ Impact	Action Required	Responsible Party	Frequency
Objective (1): Compliance with relevant legislations and erosion control			
Objective (2): Enhancement of flora and fauna			
Potential Impact: Flora and Fauna			
To protect vegetated buffer zones **To set aside hilly areas not suitable for agriculture, for conservation and possibly future mining. Endeavour to ensure maintaining some large trees as part of landscaping efforts,**	Establish conservation zone and demarcate the zone (1,649 acres)for which any future modification to the current state will require a separate clearance from the DOE. Maintain 150 feet buffer strip along River/Leave buffer strip of thirty feet along main roads to mitigate against erosion. Pine Savannah to remain as part of the conservation zone and act as buffer to adjacent wildlife corridor. All conservation zones should have demarcations and as much as possible "no hunting" signs to be placed strategically throughout the project. Avoid overuse of wildlife areas (Conservation areas and 150 feet buffer along the Sibun River. Replant possible disturbed sites (within buffer zones). Enhance cooperation towards fire management plans and fighting (in cooperation with adjacent NGOS). Fire - fighting efforts should be focused on the savannah and forested ecosystem that is a buffer zone.	Owners/ Manager	Ongoing with annual revision
	The areas disturbed by the placement of spoiled material are to be monitored and kept to a minimum.	Supervisors	
Activity: Water Use/Irrigation **Potential Impact: Excessive drawdown and contamination of River** **Objective: Ensure protection of River and ground water**	Use River as back up water for domestic use and washing only and only during the dry season. Installation of rainwater catchment systems for domestic use/washing. During drought period where irrigation is required, follow the requirements set forth by the competent authorities in the abstraction of river water.	Manager	Every six months Follow water quality monitoring plan.

Activities: Agrochemical Management **Potential Impact: Water resources contamination (River/underground)** **Objective: To enact sound agrochemical management**	Implement chemicals management plan and practice IPM and crop rotation. For details of the chemicals management plan see Chapter 7.0 The use of agrochemicals and herbicides should be limited or prohibited as far as possible. Practice IPM and crop rotation. Limit the use of aerial spraying by crop duster planes. Apply agrochemicals by mechanical means or drones preferably to reduce impacts. Restricted use of pesticides should only be used under strict control and only when no other options are available by a licensed applicator. Pesticide use near the Sibun River and tilapia farm will be avoided as much as possible.	Manager/ Supervisors/ Workers	On -going throughout life of the project.
Activities: Solid and liquid waste management **Potential impacts: Contamination of soil and water resources.** **Objective: To implement adequate waste management practices**	Adopt solid waste management plan (waste separation/storage/disposal). Liquid waste: install adequate sewage septic systems as recommended in liquid waste management.	Management	

Table 79: Mitigation Matrix for Social Impacts.

Activity/Objective/Impact	Action Required	Responsible Party	Frequency
Objective: To ensure adequate employee health and safety, and community participation.			
Activities: Social factors such as Environmental health and safety of workers & Community. ***Employee working conditions deteriorate and community welfare threatened***	Review and prepare OSH Guidelines for the use of management and employees. Maintain community links and participation in accessing green areas and buffer zone activities. Install warning signs at strategic locations. E.g. "no hunting", etc.	Management	Once off with monitoring and changes when necessary
Activity: Change to Outstanding Universal Value (OUV) **Potential Impact: Indirect impact on the OUV of WHS.**	Ensure all mitigation measures are followed, in particular those aimed at preventing contamination of water bodies and soil erosion. Farmers will be made aware of the impacts which agricultural runoff could	Owners and management	Throughout project's operational phase or operations of farms.

Objective: To keep informed on any possible changes to the OUV	have not only to the river and adjacent protected area but to the BBRS.		
Objective: **To ensure that surface water and water bodies are protected against contamination and to prevent flooding by blocked drains.**			
Activities: Continuous operational phases (INFRASTRUCTURE construction and maintenance) ***Potential Impact: Contamination of Sibun River due to storm water runoff*** ***Mitigation Measures: Drain maintenance and keeping or enhancing buffer zones***			
	Schedule inspection of drains to avoid clogging during the rainy season. Enhance buffer zones (disturbed or altered trees can be re-planted where possible to enhance their ecological value), as well as along fences and drains.	Manager/ Contractor	A month before the end of every dry season

16.3.3 Mitigation Matrices for Operational/Implementation Phase

Table 80: Mitigation measures for Implementation Phase.

Activity/Impact Mitigation	Management Action Required	Responsible Party	Completion Date or Frequency
a) Flora and Fauna			
Activity: Buffer zone/green areas maintenance **Potential Impact: Alterations due to fires, incursions, disturbances** **Objective: Install measures to protect integrity of conservation area,150-foot - wide riparian buffer and other green areas**	Conduct occasional monitoring of buffer and green areas to prevent incursions and illegal activities such as hunting and setting of wildfires. "No hunting" signs to be put in place.	Management/Supervisors	On – Going
Activity: Continuous agriculture cultivation annually **Potential Impact: Impact to flora and fauna** **Objective 1): To mitigate against the loss of flora and fauna**	In consultation with NGOS adopt fire management plan for the savannah and forest ecosystem. Areas in 150 wide buffer and road verges altered or disturbed may need a re-planting or a reseeding plan	Management/Supervisors Management	Annual training meetings Annual

b) Water use and Irrigation system **Activity: Continuous agriculture operations** **Potential Impact: Threat to water resources** **Mitigation: Manage buffer zones and adopt conservation of water as well as agrochemical management**	Irrigation of crops is to be conducted on a need basis where extreme draught threatens crop production. Planting is based on seasonal practices. Maintain integrity of buffer zones and green areas Store agrochemicals adequately to avoid spillage. Practice IPM methods recommended above. Install water catchment for water storage to reduce demand for abstraction from river	Management	
c) Agrochemical use **Activity: Agrochemical management, storage and use of fertilizers** **Potential impact: Risk of spillage and risk of nitrification** **Mitigation: Agrochemical management is adequate**	Agrochemical management should include storage of agrochemicals in accordance with PCB's requirements, transportation by means of approved methods and its application in accordance with label requirements and recommended mitigation measures, and PCB's requirements for applicators. Application of fertilizers based on recommended practices.	Supervisors/Equipment Operators , Farmers and Workers.	During planting season
d) Waste Management **Activity: Solid waste generation** **Potential impact: Risk for contamination of environment** **Objective: To adopt management plan to reduce risk of contamination**	Adopt a solid waste plan (Chapter 8.0), that includes: storage and separation of waste, temporary storage, transportation to final disposal site. Implement liquid waste management plan	Management, Farmers and workers	On -going

Liquid waste management: **Potential risk: The risk of contamination of ground and water resources with effluent**	(Chapter 8.0). This includes the installation of adequate sanitary facilities that include well designed septic tanks and leach field.		
<u>e) Infrastructure</u> **Activity: Maintenance of buildings/drains, access roads etc.** **Potential Impact: Soil compaction, possible oil spillages, soil erosion** **Objective: To adopt practices to prevent and control pollution from infrastructure operations**	Follow building guidelines and management must ensure that fire extinguishers are in strategic and visible places. Oil and fuels are to be stored in a secondary containment structure. Occasional spills to be cleaned up immediately using saw dust and sand. Drains to be cleaned prior to rainy season	Manager/supervisors	On-going
<u>f) Social factors</u> **Objective: To ensure stability through social corporate responsibility and improved livelihoods**	Ensure good public relations with the locals Develop an organized and community-based Corporate Social Responsibility Strategy to support sustainable agriculture activities, and other social activities. Keep on-going support to local NGOS in initiatives at conservation and buffer zones.	Managers, and Farmers	On-going
<u>g) Outstanding universal value</u> **Activities: Continuous agriculture productive operation** **Potential Impact: Risk for contamination of water resources**	A water quality monitoring plan has been developed in order to ensure long term monitoring of the Sibun River's water quality to prevent pollution and excess nitrification which may indirectly cause stress to marine resources.	Management	As per monitoring plans

Table 81: Mitigation and Monitoring for Occupational Health and Safety.

Activity/Impact Mitigation	Management Action Required	Responsible Party	Completion Date or Frequency
Activity: On – going working on site **Potential Impact: Threat to safety of personnel (hazards risk / harm to the personnel)** **Objective: Ensure adequate health and safety of employees**			
Ensure that all waste generation is minimized and managed in an environmentally sensitive manner	The Management must ensure that the site is kept clean and in an orderly state at all times.	Supervisors	Continuous
	Adequate measures to collect, remove and safely dispose of waste must be implemented during each stage of the proposed development from site preparation to final construction.	Manager	Continuous
	The Manager must approve the waste disposal arrangement.	Manager	Once-off
	Provision must be put in place for the formation of Environment, Health and Safety guidelines, of which the employer and workers are taken into consideration.		On-going
First aid and emergency preparedness	Provision must be made for people to be trained in first aid with a certificate issued by a recognized body.	PM, Supervisors	Continuous
Health and safety gear	Provision for suitable overalls, safety footwear, and dust masks, respirators, gloves, ear protection.	PM, DOE	Continuous
Chemicals' safety	Chemical safety data sheet of the chemical used at the plant should be kept on record.	PM, DOE	Continuous
	Chemicals should be properly labelled with content and hazard warnings.	PM	Continuous
	There should be no eating or drinking in the chemical use area.	PM	Continuous
	Chemicals should be properly stored and used in accordance with the manufacture's direction and good practice	PM	Continuous
	Containers filled with hazardous waste should be properly labelled	PM/DOE	Continuous

	and properly closed. These substances must be collected by an approved contractor and disposed of at an approved disposal site.		

16.3.4 Integrated Pest Management Plan

The Integrated Pest Management Plan will be managed following the following basic guidelines:

1. Preventive Measures

- Practice Crop Rotation: Rotate crops to disrupt pest life cycles.
- Use pest-resistant or tolerant grain crop varieties to minimize the need for chemical interventions.
- Clean equipment and storage facilities to prevent the spread of pests.
- Use high-quality, treated seeds to reduce the risk of seed-borne diseases and pests.

2. Monitoring and Identification

- Frequently monitor fields for signs of pest activity, including insect populations, disease symptoms, and weed pressure.
- Use pheromone traps to monitor specific pest populations like moths or beetles.
- Establish economic threshold levels to determine when pest populations warrant control measures.

3. Other Practices

- Adjust planting dates to avoid peak pest pressure periods.
- Proper nutrient management can help plants resist pests and diseases.

4. Biological Control

- Encourage natural predators like ladybugs, parasitic wasps, and predatory beetles that feed on harmful pests.
- Use biopesticides derived from natural materials, such as Bacillus thuringiensis (Bt), which targets specific pests without harming beneficial organisms.

5. Mechanical and Physical Controls

- Use tillage to disrupt the habitat of soil-dwelling pests

- bury crop residues that might harbour pests.
- Install physical barriers or traps to protect crops from larger pests like rodents or birds.

6. Chemical Control (As a Last Resort)
    - Use pesticides that target specific pests with minimal impact on non-target organisms, including beneficial insects.
    - Apply chemicals preferably by mechanical means or drones, only when pest populations exceed threshold levels, and follow proper guidelines to avoid resistance buildup.
    - Rotate different classes of pesticides to reduce the risk of pests developing resistance.

7. Evaluation and Record Keeping
    - Keep detailed records of pest monitoring, control measures applied, and their outcomes.
    - Regularly evaluate the effectiveness of your IPM strategies and make adjustments as needed.

16.3.5 Management Plan for the Handling of Agrochemicals

Agricultural chemicals are defined as chemicals such as pesticides, herbicides, fungicides, insecticides, and fertilizers used in agriculture to control pests and disease or control and promote growth. The agrochemical compounds management plan covers the transport, handling, storage and disposal, with associate management and reporting practices including preventive and contingency measures, in consultations with workers. The plan is necessary in order to address the following:

The plan will address the following:

1. **Transportation** – Drivers and workmen involved in the transporting and pesticides, fertilizers or other hazardous materials will have to obtain special licenses which includes special training in handling and record keeping from the Pesticide Control Board (PCB). The vehicles will need to have secure containers, emergency kits, fire extinguishers, cleaning supplies and PPE’s (gloves, eye goggles and overalls for the driver).

2. **Storage**–In order to maximize safety, pesticide storage will be done at existing headquarters in Spanish Lookout. These will be stored in accordance with the MSDS requirement for the various pesticides being stored. Only the amounts and types of the pesticides and fertilizers intended for use in the project area will be brought on site for its immediate use. The storage facility at headquarters will be locked at all times with access only to those workers who are properly trained in the usage of these compounds. The storage facilities should limit direct public access and be located away from surface water sources, areas prone to flooding and away from direct sunlight and extreme heat. The storage facilities should be properly and boldly marked.

3. **Handling** – The handling and application of pesticides will be done in accordance with the accompanying label instructions or those contained as part of the instructions in pamphlets for the various pesticides and fertilizers and in accordance with the regulatory requirements of the Pesticide Control Board. Mixing will be conducted far away from water supplies. No application equipment will be filled directly from any natural water source or surfaces that can allow spills. Protective gear will be worn by workers before opening pesticide containers and other hazardous materials. The transfer of pesticides between containers, mixing, loading and equipment cleaning should be conducted in a designated containment area in order to retain, recover any leakage or wash water.

4. **Disposal** – Pesticide and fertilizer containers and expired compounds will be disposed of as per PCB guidelines and as per the crop protection guidelines (Appendix XI). The crop protection guidelines outline the approved method for the processing, recovery and disposal of used pesticide containers. The guidelines include a) decontamination, b) storage, c) reuse, d) final disposal and e) disposal by on farm incineration (Source: Department of the Environment web site: https/doe.gov).

It is recommended that these measures be implemented in addition to those specifically recommended in Chapter 7.

16.4 Environmental Monitoring Plans

Wherever possible, this monitoring program shall establish links between impacts identified in the report and studies, measurement indicators, detection limits (where appropriate), and definition of thresholds that will signal the need for corrective actions, if any.

The monitoring plan shall include the monitoring of the physical aspects of the operations (land clearing and preparation), and the monitoring of water use/ wastewater discharge/ and changes of the ecological composition of the general area over time. Habitat enhancement and recovery efforts will be monitored annually, including the re-vegetation of flora and fauna (where removal was a temporary activity); the monitoring of the abundance of species, with a focus on endangered species, and the monitoring of workers health and safety.

The responsibility to enact this monitoring plan as well as the mitigation plan will rest on the Management, who designates trained personnel to conduct the monitoring and reporting.

Water abstraction from the Sibun River for irrigation will only take place in drought condition that is likely to threaten crop failure, as planting of crops depends on seasonal rainfall. Therefore, water abstraction is minimal and done only during the dry season for domestic use (washing, flushing of toilets and washing of equipment). The volumes extracted do not exceed two thousand gallons per month.

16.4.1 Monitoring the Physical, Biological, Health and Social Parameters

Tables 82 to 85 provides summary of the recommended Monitoring Plans addressing the main issues of concern and the effectiveness of the mitigation measures being implemented.

Table 82: Monitoring Parameters for the Physical Environments.

Parameters	Frequency	Critical Effects	Location/Area
Flow rates and volumes of creeks and mid Sibun River	bi-annually	Changes in volumetric flow	Sibun River
Microbiological levels of water bodies	Quarterly 1st year, then bi-annually	'Zero' CFU/100 ml	Sibun River and principal tributaries in the vicinity of project site
Inorganic compound concentrations of water bodies (Sulphate,	Quarterly 1st year, then bi-annually	Concentrations within or below recommended	Sibun River and creeks/streams in the vicinity of project site

Phosphate, Nitrate and Ammonia)		limits for fresh surface water	
Erosion	Twice in wet season	No significant soil loss	Flood plain and Riparian Forest
Improved drainage	Twice in wet season	Reduced localized flooding. Improve flow	Lowlands or 'bajos' prone to annual floods and seasonal submersion
Groundwater and pond water quality	Bi-annually	Reduce contamination. Institute water treatment protocol	SLCCL Farming Development

Table 83: Monitoring Parameters for the Biological Environments.

Parameters	Frequency	Critical Effects	Location/Area
Rate of Re-vegetation of degraded areas	Annually	Acceptable level of re-vegetation	Degraded areas due to lands put into cultivation or bush fires.
Rate of regrowth of 1of degraded riparian forest	Annually	Re-established degraded riparian forest	Sibun River and principal tributaries in the vicinity of project site
Soil profile	Annually	Acceptable soil fertility level	Project zone
Pests	Annually	Pests, rats, etc. seen in area	Crop fields
Integrity and viability of reserved areas and wetlands or floodplain	Annually	Acceptable state for wildlife and natural reservoir in wet season	Lowlands and biological corridor zone or reserves for wildlife

Table 84: Monitoring of Human Health and Safety, and other Social Concerns.

Parameters	Frequency	Critical Effects	Location/Area
Monitor Human Safety particularly with respect to possible exposure to natural and technological hazards	Weekly during planting and harvesting. Have a medical emergency & evacuation plan for machine operators and farm hands.	Reduce and mitigate accidents	Entire SLCCL farming development site
Monitoring of internal environmental health and safety (lighting, physical equipment, noise level, traffic, etc.)	Monthly, during farming operational phases (land preparation, planting, and harvesting)	Worker's security and safety	Entire SLCCL farming development site
Adequacy of Workers' quarter during busy farm operation periods	Weekly	Reduce accidents and delay	Entire SLCCL farming development site
Security of employees	Daily during busy farming periods	Reduce accidents and delay	In cultivation parcels

Emergency plans	During operational phase within the crop cycle	Saving of life and property. Cost reduction.	Entire SLCCL farming development site
Social benefits	Monthly basis for workers during the cropping season	Keep workers secured and safe	Project administration
Social community participation	During active farming operations	Reduce animosity and fear	Stakeholders in the vicinity of the farming development zone

Table 85: Summary of Water Resources Monitoring Plan.

Potential Impacts	Parameters	Frequency	Critical Effects	Location/Area
Water Quality (surface and groundwater)	As per ECP	Quarterly 1st year then Bi-annual	As per schedules determined by the ELR, 2009	Sibun River and principal tributaries in the vicinity of project site
Hydrology	Stream flow	Seasonal	Flood levels and baseflow	Sibun River and principal tributaries in the vicinity of project site
Drainage	Efficiency of canals	Wet season; cool transition period	Flood stage	Wetlands, 'bajos', and floodplain
Water for future irrigation system	As per water abstraction license	Monthly during dry season	As per concession	Mainly from the Sibun River and principal tributaries in the vicinity of project site
Groundwater Resource protection & conservation	As per water abstraction license; potentiometric level monitoring	Monthly during dry season	Pumping rate tests.	Future groundwater abstraction wells in the SLCCL farming development site

16.4.2 Water Quality Monitoring Plan

The water quality monitoring plan has partly been established based on findings during the EIA preparation (see Chapter 2 Section 2.8 Baseline Water Quality. Three monitoring sites were selected for monitoring that included the sites at the Sibun River at 1) Monkey Bay, 2) Tiger Sandy Bay River, and (Sibun River Downstream). These three sites will help determine pollution since the Monkey Bay site is upstream of the project, while site two is within the project itself and the final river site is downstream near the end of the parcel across the Coastal Plain Highway. This monitoring plan will be implemented for the next three (3) years, after which it shall be reviewed

and amended in consultation with the DOE. Table 87 shows the GPS coordinates of each site and Figure 89 Shows the location of these sites.

Table 86: Water Quality Monitoring Plan – Years one to three.

PARAMETERS	FREQUENCY	CRITICAL LEVELS	AREA LOCATION
IN-Situ: Temperature, Dissolved Oxygen, pH, Salinity, Turbidity, Total Dissolved Solids, Specific Conductance	Every six months – (bi-annually)	20% above existing levels (see baseline data)	Sites 1 to 3 as described above. Site coordinates: Site 1 (Sibun River at Monkey Bay) N 3347.92 E 19131.89 Site 2 (Sibun River at SLCCL) N 3371.39 E 19138.66 Site 3 Sibun River Downstream N 3382.92 E 19181.05
Laboratory: Ammonia, total Nitrogen, Total suspended solids, alkalinity, chemical oxygen demand, phosphates, Nitrates, faecal coliform	Once per year	30% above existing levels or as per Effluent Licenses	As above

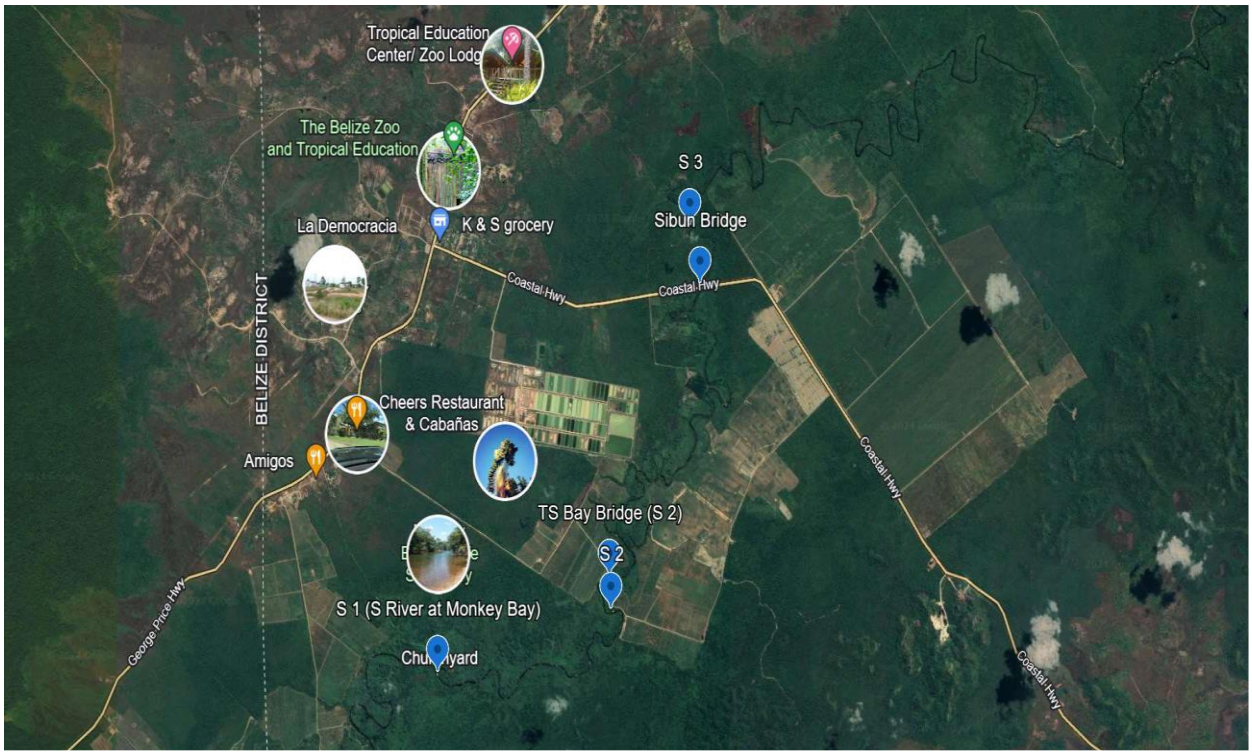


Figure 89: Location of Proposed Water Quality Sampling Sites.

16.5 Quality of Available Data

The research team did its work within the context of an existing agriculture project site that had operated mechanized farming for years prior to the new owners acquiring the property. Based on this pre-existing physical and biological setting, the EIA was focused on the principal areas of research, gathering of baseline data and recommending mitigation measures based on the findings but also influenced on the existing practices.

Data was available in terms of the property layout and farm design from the owners. Existing data of flora and fauna was limited as large portions of the property had already been cleared for cultivation. However, transects for the gathering of baseline data on flora and fauna was done to represent the existing but fragmented ecosystems. It would have been helpful if data from the NGO community was easily forthcoming, but this was not the case.

In terms of available literature, some reports for projects nearby were helpful in terms of indicating the flora and fauna. For example, the EIA documentation for the Coastal Highway Rehabilitation project gave an indication of the type of flora in the ecosystems nearby. Similarly, the LLES for Cementos Progresso and the flora and fauna information collected over a more extended period of

time from the two nearby conservation protected areas (Monkey Bay wildlife Sanctuary and Runaway Creek Reserve) would indicate that the faunal species and their composition is likely to be similar for that of the project area.

There was also valuable archaeological information on the general archaeology of the area in particular the Hilly terrain portions containing caves with a few archaeological artefacts. The availability of LiDAR imagery of the project area was also very useful in the assessment of the project area.

16.6 Decommission Plan

The project is owned by a consortium of landowners. As a result of this, the project is planned as a long-term investment and at this time would be early to prepare a detailed decommissioning plan.

16.7 Conclusion

The proposed development plan for the 6,797 acres of land and its proposed uses to have the hilly areas and pine ridge areas zone for conservation or future potential ecotourism development and mining activities which would require separate environmental clearances at the time of project proposals and the utilization of flat fertile soils for agricultural development is very much consistent with the potential land use of the project area identified in previous studies.

In addition, this project is supportive of GOB's effort in ensuring Belize's food security. Of the 4052 acres of land slated for agricultural use, more specifically the growing of grain crops, 2,751 acres had already been cleared with only 1,301 additional acres proposed to be cleared. The area proposed for agricultural use are located in land systems that have been classified for agriculture production. It is the EIA Team's opinion that with the implementation of the recommended mitigation and monitoring measures contained in the ESMP that most of the identified negative impacts can be adequately addressed and that the potential socio-economic benefits support its implementation.

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